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PYE'S
SURGICAL HANDICRAFT:
A MANUAL

OF

SURGICAL MANIPULATIONS, MINOR SURGERY, AND OTHER MATTERS CONNECTED WITH THE WORK OF HOUSE SURGEONS AND SURGICAL DRESSERS.

WITH 300 ILLUSTRATIONS ON WOOD.

First American from the Third London Edition.

REVISED AND EDITED BY

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SURGICAL REGISTRAR TO ST. MARY'S HOSPITAL; AND SURGICAL TUTOR AND JOINT LECTURER ON PRACTICAL SURGERY IN THE MEDICAL SCHOOL.

NEW YORK:
E. B. TREAT, 5 COOPER UNION,
1893.

PREFACE TO THE THIRD EDITION.

In preparing the present edition for the press, I have made such alterations and additions as seemed necessary to place the book in accord with the surgical procedures of the present time.

My endeavour has thus been, while maintaining the scope and character of the work unchanged, to make the book still more useful than it has hitherto proved itself, and at the same time to depart in no degree from what (as far as I can judge) would have been the wishes of the Author respecting it.

T. H. R. Crowle.

3, Campden Hill Road,
Kensington, W.,
October, 1891.

277385

PREFACE TO THE SECOND EDITION.

A NEW edition of "Surgical Handicraft" has been required too soon after the date of its first appearance to allow of any great alteration in the plan or scope of the work. Nevertheless I am hopeful, that in its present form, the book is a better one than it was. By alterations in the type and style of printing, and by excision of unnecessary verbiage, its bulk has been lessened, although much new matter, and many new illustrations have been added. The price has also been much reduced.

I have carefully revised the letterpress throughout, and I hope that now there are but few positive errors; if this be so, I feel that it is greatly due to the help which I have received at the hands of those, who in reviewing the first edition in the different journals, carefully, and always most kindly, pointed out the errors of fact and omission into which I had fallen.

The new matter partly consists of notices of those recent advances in the handicraft of surgery which seem likely to have a permanent value, in respect of which I hope that the book is written up to date, and partly of alterations. Thus I have re-written the account of the fitting of trusses, and much of the chapters on Listerian dressings; have added to those on spinal jackets, and upon local anæsthetics, etc.

I have again to thank my friends the authors of the chapters upon the special subjects of the surgery of the teeth and of the ear, and upon the administration of anæsthetics.

October, 1885.

PREFACE TO THE FIRST EDITION.

In this book I have endeavoured to describe the details of surgical work as it appears from the point of view of house surgeons and dressers in surgical wards.

My aim has been, further, to present this work to them, as to men apprenticed to a skilled labour, in which excellence can only be attained by the acquisition of manual skill or handicraft; for although surgery is doubtless becoming more scientific day by day, and although it may even now have come to pass that with the increasing recognition of its higher aims, its manipulative side is unduly overshadowed, nevertheless Chirurgery can never be false to its etymology, χειρ εργον, will never cease, that is, to be a skilled labour, nor will surgeons ever cease to be handicraftsmen.

This main idea I have wished to express in the title I have chosen, and it has been very far from my desire to write in any sense an elementary work on theoretical surgery. Still I am conscious of having been forced in some places to treat of abstract surgical questions, and to sacrifice absolute consistency if by so doing I could better explain necessary manipulations.

The original wood cuts have been almost entirely drawn from photographs taken from actual patients or subjects, by Mr. A. Wood, M.R.C.S., and Mr. A. E. Black, and through their assistance I hope to have secured a somewhat faithful representation of the real appearance of bandages, splints, etc.

Space will not allow me to thank by name all those who have willingly helped me. My obligations to my colleagues, Mr. Howard Hayward and Mr. Field, and to my friend, Mr. Mills, for their chapters on subjects which required special knowledge, and also to Mr. Herbert Page and Mr. Spencer Smith for the revising of the proof sheets, are very great, and I feel that I can in no fitting way express my sense of the kind and patient aid the last named has afforded me. My thanks are also due to Mr. J. J. Clark for his preparation of the index.

WALTER PYE.

4, SACKVILLE STREET, W.,
September, 1884.

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ERRATA.

Page 57, line 33, for "sharp" read "blunt."
" " " 38, for "blunt" read "sharp."

SURGICAL HANDICRAFT.

SECTION I.

ON THE ARREST OF HÆMORRHAGE.

CHAPTER I.

OF HÆMORRHAGE GENERALLY.

HÆMORRHAGE is any escape of blood from its vessels, whose walls, through injury or disease, have been divided or torn. It is commonly described as being *capillary*, *venous*, or *arterial*. Definition.

There are few accidents which test the qualities of courage, readiness, and energy, more than the occurrence of a violent hæmorrhage; and, in such a case, the prompt adoption of common-sense measures will be found to be of far greater service than any routine of book-learnt rules.

General rules for arrest in emergency.

A few general principles bearing on this subject may be shortly considered, under the heading of "The Primary arrest of urgent Hæmorrhage."

The measures which must be taken on the first emergency are,

(1) Encouragement of the process of natural arrest, by exposure to the air, attention to position, and getting free circulation towards the heart in the veins.

(2) Prompt digital pressure, on the wound first, and afterwards upon the trunk vessel, if necessary.

(3) Absolute quiet, and the recumbent position.

Natural arrest, *Position*, and *Pressure*, are the cardinal points in the primary arrest of hæmorrhage.

Natural arrest in capillaries.

Arrest in capillary hæmorrhage is usually simple and quick enough. The capillary vessels proper contract, and the blood coagulates over the surface of the wound, while underneath the surface of this coat of clot there is poured out a layer of highly coagulable lymph, which seals up the ends of the vessels, and is the first step towards the repair of the injury.

In veins. In the veins, the chief agent in natural arrest is the contraction of the venous walls, combined with coagulation of the blood. This contraction occurs at the cut ends only, and does so more rapidly than in the case of arteries, so that one may often see the veins on the face of an amputation stump distended with blood but with their ends completely closed, so that they take the shape of nipple-like projections.

Veins do not appear to retract so perfectly within their sheaths as arteries do; with regard to the later stages of the process of natural arrest, such as the formation of external and internal coagula, etc., all that need be said here is that in its general outlines the process is similar to what happens in the case of arteries, but that it is somewhat less perfect.

In arteries. In the natural arrest of arterial hæmorrhage, it is convenient to recognise two stages, which may be termed those of primary and permanent arrest.

Primary arrest. The process of primary arrest in the case of small arteries consists *(a)* in the coagulation of the blood effused around the vessel, over its mouth, and between its sheath and its proper wall, *(b)* in the gradual contraction of the mouth of the vessel, and the formation of a coagulum in the lumen of the tube, *(c)* in the retraction of the vessel within its sheath.

Permanent arrest. The process of permanent arrest is a gradual one, and often takes weeks to complete. It consists *(a)* in a continued retraction of the vessel within its sheath, *(b)* of a general shrinking up of the vessel itself and the parts in the neighbourhood, *(c)* of a disappearance of the clots and effused lymph, partly by absorption, partly by fibrous changes, and *(d)* of an organisation of the internal coagulum. Finally all that is left of the divided vessel, up to the nearest offshoot, is a fibrous cord which itself will subsequently disappear.

Importance of *Syncope*. If the vessel divided be a large one, or if from any cause the bleeding has been copious, there is added another factor in the arrest, namely, *syncope*, which within certain limits is often a most fortunate occurrence for the patient, for the lowered action of the heart ceasing to pump the blood into the vessels, gives time for clots to form, and for contraction and retraction to go on.

Importance of *Position.*

Blood, like water, will not run up hill except upon compulsion. The effects of *Position* and of an unhindered return of blood to the heart are thus very important. Yet how often may we see a man with severe epistaxis stooping over a basin, his neck the while encircled by a tight collar; or a bleeding varicose ulcer, with a garter grasping the saphena vein.

Importance of exernal pressure with the fingers.

Of *Pressure,* again, it has been well said, "There is no bleeding from the exterior of the body which cannot be temporarily arrested by firm pressure with the fingers." * It matters not for the moment whether the bleeding be arterial, or venous, or capillary; the thing required is to stop it, and pressure will always do this. Too much stress should not be laid upon the kind of vessels involved in the bleeding. A distended vein may bleed as furiously as an artery; so may a mass of capillaries in inflamed tissues. But in all, the first means of arrest must be local digital pressure.

General directions for arrest of hæmorrhage.

General directions for the arrest of capillary and venous bleeding, and of severe mixed hæmorrhage from injuries, requiring plugging, etc., will now be described.

The surgical arrest of true arterial hæmorrhage is given fully in Chap. II.

Capillary hæmorrhage.

Value of cold and exposure.

Brisk bleeding from small arteries, veins, or capillaries, is often best checked by simply keeping the wound cold. Exposure to the air, or to a stream of cold water will aid the process of natural arrest, while swathing up the injured part, may, by the increased heat produced, directly increase the escape of blood. Pressure is sometimes useful, and limited incisions, or abrasions of vascular tissues, with few exceptions, are followed by oozing of blood which stops in a few minutes, or "by itself," and needs no further notice.

Venous hæmorrhage. General principles.

Venous bleeding.—In some books, especially in those which are written to gratify the taste of the outside public for amateur or domestic surgery, we may still read that venous bleeding occurs only from the distal end of the cut vessel, and therefore the proper thing to do in the case of a cut vein, is to put a pad somewhere below the wound. Such directions are wholly misleading. For ordinary venous bleeding, the first thing to see to is that there is nothing hindering the return of blood to the heart. Next, to remember that almost all venous bleeding will cease on raising the limb;

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* Erichsen's Surgery, 8th Edition, Vol. I., p. 401.

and thirdly, to remember that pressure will always effectually stop the flow of blood, if it be applied to the wound itself.

The measures which are most immediately effective for the restraint of severe hæmorrhage from vessels of all kinds, provided it is caused by external violence, now remain to be considered.

Thoroughness essential.

Pressure will here be even more necessary than in the other forms, and to be effectual it must be attained by plugging. Harm can only come of tying up a wound in a half-hearted way, laying on covering after covering, rather with the idea of hiding the danger, than mastering it. On the other hand, a furious rush of blood, such as may come from a wounded carotid, or a ruptured aneurism, may be for a time controlled by a firm and judicious plugging of the wound, followed by pressure over it.

Plugging and pressure.

Materials for plugging.

Medicated wool.

The best and most convenient material for plugging a wound is some one of the absorbent and medicated preparations, having as a basis cotton wool from which the fatty particles have been removed, such as the "sal-alembroth" wool, which has incorporated in its meshes mercuric perchloride. This material is generally stained blue for distinction from ordinary absorbent cotton. The bicyanide wool recently recommended by Sir Joseph Lister, salicylic and boracic acid, iodoform, and some other antiseptic preparations, can be also incorporated with wool or gauze, and used for plugging. All this kind of material should be used dry, small pieces being packed away with a director, until the wound or cavity is filled.

Lint.

In a similar fashion must the narrow strips of lint be packed into the wound, very gradually but firmly, care being taken that the deeper parts of the wound are plugged as well as the more superficial ones.

Cotton wool.

If simple cotton wool be used, it will generally be found best to soak it first in water, so as to express the air from its interstices, but in any case, as with the two preceding materials, the packing must be done bit by bit, and very firmly.

Sponge.

Pieces of sponge make a good plug used dry, or with some iodoform dusted on them after they have been washed in an antiseptic fluid. Being elastic they can be made to exercise considerable pressure. In deep wounds, or in such places as the vagina, rectum, or pharynx, it is wise to attach a string to the sponge, to be able to recover it.

In recent surgery there is a growing distrust of sponge as a plugging material for temporary bleeding, and still more as a more permanent means of arrest.

The wound when plugged, usually requires a firm compress over all. This may be conveniently made of several layers of lint, cut to the required shape, and secured by a roller bandage; or by a triangular or scarf bandage arranged so that the knot comes over the pad.

The graduated compress.

It is often necessary to make a compress which shall be much thicker in the middle than at the edges. This is effected by what is known as the "graduated compress," a series of pads of similar form, but diminishing in size, placed one on the top of the other until a more or less flat-topped pryramid of lint is made.

The principal use for this sort of compress is for wounds in such situations as the palm of the hand, the axilla, etc., where it is often very difficult to secure efficient direct pressure.

It must not be supposed that all, or even most wounds require to be plugged. A pad and bandage firmly applied will be sufficient to check most hæmorrhages, and it must be remembered that plugging destroys all chance of healing except by granulation.

How long should plugs or pads remain untouched?

At the present time the materials chosen for plugging or covering a wound are all presumably aseptic at starting, and many remain so for days or even weeks. But there is always a risk, in leaving the cavity of a wound which has been plugged for the arrest of bleeding longer than twenty-four hours, that if pressure is continued, as it must be if the flaccid walls cannot be brought together otherwise so as to obliterate its cavity, gangrene of the part may take place, while, if the compression is relaxed only, the bleedings from the vessels injured in its walls may fill the sac with loose blood clot.

CHAPTER II.

OF THE METHODS OF ARREST OF ARTERIAL BLEEDING.

THE proceedings to be taken for the immediate arrest of bleeding, which have been described in Chapter I. as being appropriate in cases of accident or emergency, have naturally to be adopted on the spur of the moment, before detailed examination of the injury, and with the single object of stopping the loss of blood, and maintaining the heart's action.

In most instances it will be found that serious bleeding, when it follows a recently inflicted wound, comes chiefly from one or more arteries, and that unless these can readily be arrested by direct pressure by a pad or plug upon their torn or divided ends, they must be secured by some form of ligature tied round their mouth; or some other of the plans of constriction, presently to be described, must be adopted. But in many cases of accidents this is not immediately possible, while in that of vessels being divided or wounded in the course of a surgical operation it would be often inconvenient; so that it is a frequent practice to cut off the blood supply from the limb or part of the limb which is concerned, by compressing the trunk of the vessel against the bone, or in some similar way.

We will begin then by considering the special means of arrest of arterial hæmorrhage by compression.

OF SOME SPECIAL MEANS FOR THE ARREST OF ARTERIAL HÆMORRHAGE.

Arterial hæmorrhage continued. Special means of arrest. (1) Immediate arrest by digital pressure.

(1) *By Digital Compression.*

The procedure which of all is the simplest, in most cases the most efficient, and the readiest in cases of severe arterial bleeding, is the compression of the trunk vessel with the finger above the seat of the injury, against some neighbouring bone. It is of course only applicable in cases of hæmorrhage in certain places, such as in the limbs, the neck, and some parts of the head and face. Moreover, unless relays of capable assistants can be procured, it cannot, in consequence of the fatigue it produces, be continued for more than ten minutes or a quarter of an hour. Long before that time, however, help may have arrived, or some improvised tourniquet *(vide infra)* may be applied.

The great value of digital compression lies in the fact that it can be applied at once, when those moments on which a life may hang will have been seized and saved.

With regard to the compression itself, practical experience alone will enable the surgeon with absolute confidence to place his finger on the spot beneath which the artery is beating, and in the performance of it there are one or two points to attend to.

He should endeavour as far as possible to compress the vessel only. Great pain is caused by bruising large nerves against the bone, and if in pressing the artery he at the same time compress the large venous trunks, or with the hands partially strangle the limb, the venous congestion, and therefore the general bleeding is increased.*

In compressing we should get the artery fairly against the bone, and press directly upon it. In this way a very

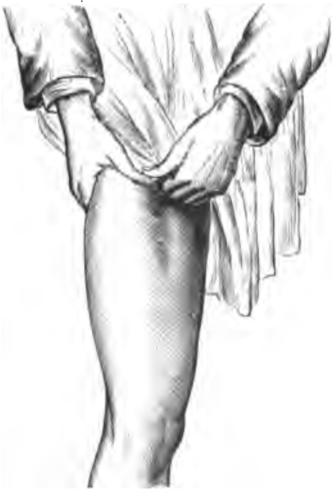

FIG. 1.—*Position of Hands Compressing an Artery.*

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* At the same time it may be mentioned that in the case of a child, or a small limb, it is often not a bad plan to firmly grasp the whole limb with one or both hands and strangulate everything completely. It is the middle course which is here the most unsafe.

moderate amount of pressure will suffice, and the pressure should be always as little as possible.

The position of the hand and finger to be employed will vary, but as a rule the thumb had better be used to make the pressure (Fig. 1), and reinforced if necessary by that of the other hand. The limb must always be raised.

Compression of particular arteries.

The position and compression of particular arteries.

The following directions for the digital compression of particular arteries will serve also for their compression by the various forms of tourniquets, improvised, or of the regulation patterns. The accompanying diagram (Fig. 2) gives the position of the vessels in the situations where they may be compressed against adjacent bones. For the anatomical relations of these vessels the student is referred to the ordinary text books.

Of head and neck.

The arteries of the head and neck.

In cases of injury to the scalp, the underlying skull affords an admirable resisting surface for compression, and in speaking of scalp wounds this will be again referred to, but the compression of a main trunk (such as the temporal or occipital on the head), at a distance from the wound, is not often effectual, in consequence of the extremely free anastomosis existing all over the surface. Nevertheless, in some cases, compression of the trunk of one of these vessels may be useful. In such a case they are readily found, and a very slight pressure against the bone with the fingers will suffice.

Occipital artery.

The *occipital artery* on the scalp at first lies behind the mastoid process, and higher up may be felt pulsating, and may be compressed half an inch behind, and on a level with, its base.

The temporal.

The *temporal* artery splits up into main divisions soon after it passes over the zygoma, and should, therefore, be compressed against that process of bone, immediately in front of the tragus of the external ear.

Some of its branches may also be felt, and may be compressed higher up on the frontal bone.

The facial.

The arteries of the face, like those of the head, anastomose so freely that the compression of their trunks only arrests incompletely the circulation in their branches.

It is, however, frequently necessary to compress either the facial trunk, or its coronary branches, as they encircle the mouth.

The trunk of the *facial* artery may be easily found, an inch in front of the angle of the jaw, and may be compressed there.

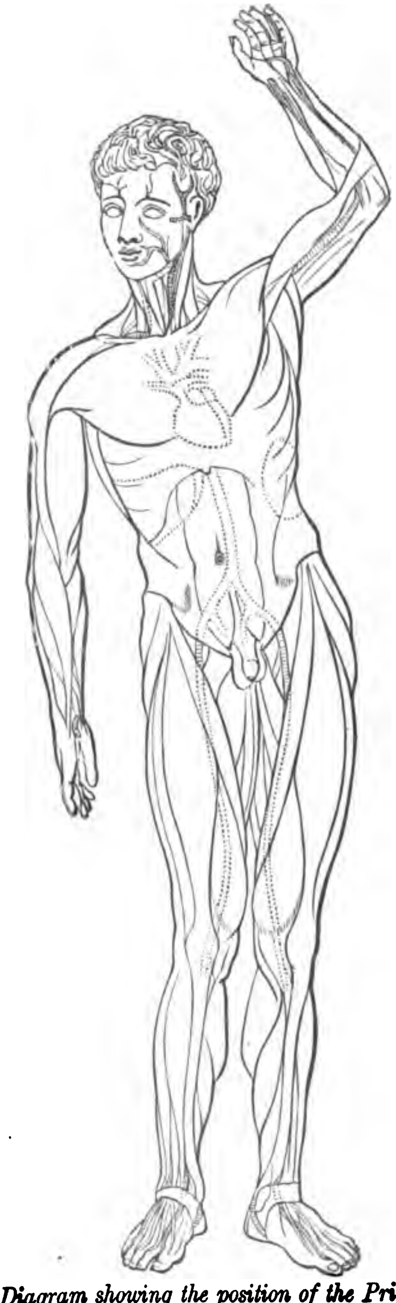

FIG 2.—*Diagram showing the position of the Principal Arteries.*
See p. 8.

The coronary. The *coronary* arteries form an exception to the rule of making digital compression against bone, for they are best compressed between the fingers introduced into the mouth, and the thumb on the face. They run round the mouth close beneath the mucous membrane, and about the third of an inch from the border of the lips. Their compression is often required in cases of operations, or cuts about the lips, and may then be effected between the blades of a pair of bulldog (*see* Fig. 16) forceps, or by the use of special "harelip" forceps, of which there are one or two patterns (*see* Fig. 3).

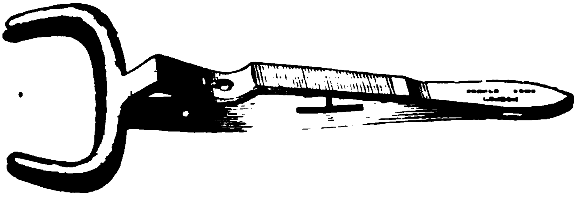

FIG. 3.—*Harelip Forceps.*

The neck; common carotid arteries. In the centre of the neck the only artery which ever has to be compressed is the *common carotid*, and the operation requires considerable care, in consequence of the proximity of structures which may not themselves be safely pressed on, such as the vagus nerve, jugular vein, trachea, etc.

The thumb should be placed over the artery at the level of the transverse process of the sixth cervical vertebra, which is about 1½ inches above the sterno-clavicular articulation; pressure should then be made *inwards* and backwards. In this way the artery is forced away from the vein and nerve, and is compressed against the transverse process or the "carotid tubercle." *

The subclavian. The *third portion of the subclavian* is the only one which it is possible satisfactorily to compress, and it is here sometimes very difficult, sometimes very easy, to occlude.

The bone against which it is to be pressed is the upper surface of the first rib, immediately outside the tubercle for the insertion of the scalenus anticus. In children or thin people, pressure behind the clavicle downwards and *back-*

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* In some works on medicine and surgery intended for the general public, this compressing of the carotid artery is spoken of as if it was the easiest and most comfortable of proceedings; indeed, we have seen it recommended for epistaxis, and this too in a work published "by Authority."

wards, at the inner margin of the subclavian triangle, will control the circulation, no matter what the position of the limb and neck may be, but in even moderately fat people it will be necessary to depress the clavicle and shoulder, to bring the artery near enough to the surface. This is usually easy enough to do, but it occasionally happens in the course of operations about the axilla or shoulder, that the limb is required by the surgeon to be raised, while the assistant in charge of the vessel would prefer that it should be kept depressed. Especially does this happen in amputation at the shoulder joint, where, just at the moment when efficient pressure is most required, (*i.e.*, just after the limb has been removed) the clavicle, freed from the downward drag of the arm, rises in the neck in a very exasperating fashion.

Various devices, such as the handle of a door key (Fig. 4), properly padded, a surgical "key" of a somewhat similar form, etc., have been devised to meet the difficulty, and it is sometimes advisable to divide the skin, platysma, and fascia over the triangle, so that the finger may be placed effectually on the artery. This may be readily done by dragging the skin downwards, and dividing it on the clavicle, as in the first stage of the operation for ligature of the subclavian.

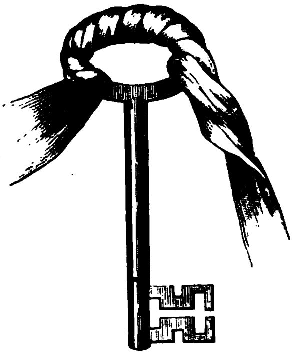

FIG. 4.—*Handle of Door Key, padded.*

This incision is sometimes, no doubt, absolutely necessary, but with regard to the use of the key, etc., nothing is so effective a compressor as the thumb, if it be put in the right place. The mistake which is generally made is either making the pressure far too much outwards, near the acromion, or else not sufficiently backwards as well as downwards.

The axillary artery.

The first portion of the *axillary* artery can hardly be reached for compression, except after incision below the clavicle. The lower half of the second, and the third parts, however, are tolerably superficial, and can be compressed in the armpit, if that region be exposed by raising the arm. The pressure is made against the humerus in the same manner as in the following instance, and the vessel can be localised quite easily as it crosses to the outer side of the axillary space, and then lies amidst the trunks of the brachial plexus, with the coraco-brachialis to its outer side.

The brachial artery.

Brachial Artery.—This artery probably more frequently requires compression than all the others put together, by reason of the great number of accidents to which the upper limb is liable.

It may practically be said to be sub-cutaneous in its whole length (Fig. 2), and may be compressed very readily against the humerus. The inner edge of the biceps which overlaps it in the middle third, is the guiding line for the vessel.

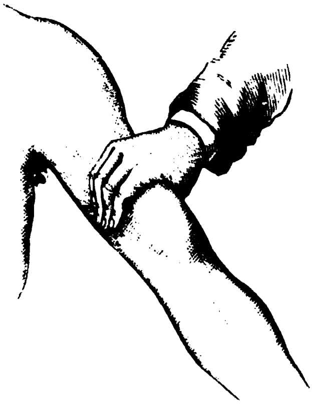

FIG. 5.—*Digital compression of the Brachial Artery.**

Fig. 5 shows the method usually employed, but the artery is more easily and firmly compressed if the hand be placed as in Fig. 6.

Arrest by flexion.

In flexion, too, of certain of the joints, we have a most valuable means of stopping arterial bleeding.

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* Some text books state that the inner seam of the coat sleeve is a guide to the brachial artery of the wearer. This is foolish.

The positions of the brachial artery at the elbow, of the popliteal behind the knee, and of the femoral at Poupart's ligament, are such, that forcible flexion of elbow, knee, or hip joints, combined with placing a firm pad in the hollow of the joint, will, in many cases, completely stop the blood supply to the limb.

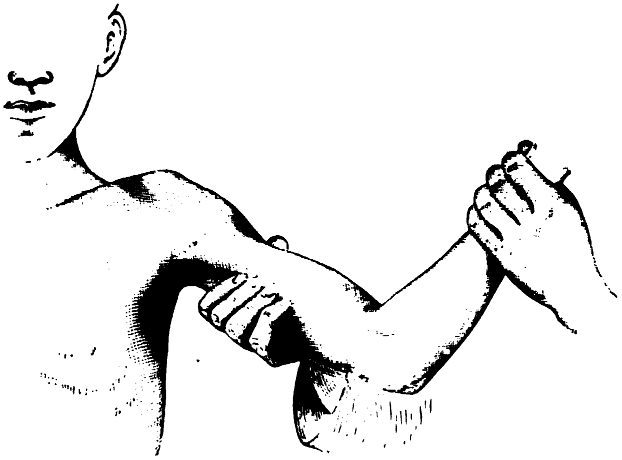

FIG. 6.—*Alternate method of compressing Brachial.*

The flexion must be forcible, and may be maintained by fixing the limb with a bandage. An example of its application will be adduced *à propos* of bleeding from the palm of the hand.

At the bend of the elbow.

At the bend of the elbow the artery may be compressed by the fingers, but not easily, and therefore arrest of hæmorrhage by flexion is preferable.

In the forearm also, except at the wrist, the circulation in the *radial* and *ulnar* arteries can hardly be controlled by any means, short of strangulation. At the wrist, however, both arteries become superficial, the radial somewhat more than the ulnar. The former lies between the tendons of the flexor carpi radialis and the supinator longus, the latter between the radial border of the flexor carpi ulnaris and the flexor sublimis, and here they may be readily compressed. The digital compression of the palmar arches is practically inconvenient, and the pressure is usually made in other ways. (See bleeding from wounds of palm.)

The aorta. The digital compression of the *abdominal aorta* is in some cases not so extremely difficult as is often supposed. It can generally be effected in children unless they are very fat, and in adults if they are thin, have lax abdominal walls, and a bold anterior vertebral curve, and in women, especially in those who are sparely nourished and have borne children.

The spot where this compression should be made is shown in the diagram as a point three-quarters of an inch above a line drawn across the abdomen from one iliac spine to the other (the level of the aortic division into the two iliacs), and a little to the left of the middle line. But before pressure is made, the exact position of the artery should be ascertained, for it frequently is in the middle, or may even deviate somewhat to the right.

The digital compression is best and most readily made by the middle and forefinger of one hand, beneath which a small pad of lint should be placed, reinforced by the pressure of the fingers of the other hand. Pressure on the inferior cava trunk must be avoided as much as possible.

The umbilicus is sometimes given as a landmark for the vessel, but investigation has shown that its place is so variable that it should not be taken as a trustworthy guide.

Common and internal iliac arteries. In some cases a moderately small hand well oiled can be introduced into the rectum, and pressure may be made upon either the *common or internal iliac* arteries by the fingers.

This procedure is not, however, at this time a common one. In the first place the introduction of the hand has to be performed under an anæsthetic, and very gradually, so that it is of little use upon an emergency; and secondly, the general belief is that the operation is one attended by considerable risk of damage to the gut and its coverings.

Possibly however this mode of compression might be found useful in some rare cases of primary or secondary hæmorrhage, from the sciatic or gluteal vessels, in a diffuse gluteal aneurism, or some analogous hæmorrhage.*

A more efficient way of effecting this pressure will however be found in the very ingenious method which has been devised by Mr. Davy of compressing the common iliac artery on either side, against the brim of the corresponding side of the pelvis, by the manipulation of a rod in the rectum. This instrument is commonly called "Davy's lever," and is simply a round smooth stick of metal or wood, about 18 inches long, and about ½ inch thick at its widest part, which is the end, with a gum elastic sheath.

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* For further remarks on the introduction of the hand into the rectum, see Mr. Walsham's paper on the subject in the St. Bartholomew's Hosp. Rep., vol. xii., 1876. The hand (he says) must not exceed 7½ inches round.

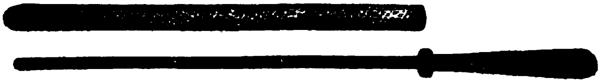

FIG. 7.—*Davy's Lever for the Common Iliac Artery.*

This, warmed and oiled, is introduced up the rectum, until it can be felt through the abdominal walls over the situation of the artery. The assistant in charge then raises the handle, and since the tissues of the perinæum act as a fulcrum for the lever, its rounded end is depressed upon the artery, and arrests the circulation. Davy's lever is chiefly used for amputation at the hip joint, but it is obviously capable of many other applications, *e.g.*, in operation for gluteal aneurism, etc. It should, however, not be employed by an unskilled assistant who has not seen it used, and practised holding it in position. The absence of pulsation in the common femoral will be the indication of the compression.

Common femoral artery.

Compression of the *common femoral* artery as it lies over the arch of the pubes is frequently required. In this situation the circulation may be completely controlled by making pressure directly downwards, *i.e.*, at right angles to the surface, midway between the pubic symphysis and iliac spine.

Care must be taken to avoid pressure on the vein as far as possible; this is best done by putting a small pad of lint underneath the finger. Frequently, however, the vein is so far behind the artery, even when they come through into the thigh, that it cannot escape the pressure.

The inguinal glands, too, as they lie parallel with Poupart's ligament, must be avoided, and if they are enlarged, this is sometimes very difficult.

Superficial femoral artery.

The line of the *superficial femoral* artery is one taken from the point above mentioned between the symphysis and spine, and the inner side of the internal condyle of the femur.

When the knee is slightly flexed, and the thigh rotated outwards, firm pressure all along this line will generally succeed in stopping the current of blood, but as the artery gets deeper in its course, more and more force will be required; the artery, also, cannot be pressed directly against the bone.

Popliteal and tibial arteries.

As in the case of the brachial artery at the bend of the elbow, so with the popliteal, digital compression is very inefficient, while the circulation may be readily stopped by flexion. If a firm pad, about the size of a hen's egg, be placed in the hollow of the knee, and the knee be then bent up on it, the circulation will be quite stopped.

At the ankle.

By any means short of complete strangulation of the limb, it will not be found possible to compress either the *anterior or posterior tibial* vessels in the legs, but the posterior one becomes quite superficial as it lies a little internal to the middle of the hollow between the heel and the inner ankle, going with the nerve beneath the annular ligament, between the common flexor of the toes, and the special flexor of the great toe.

Dorsal artery of the foot.

The dorsal artery of the foot, the continuation of the anterior tibial, may be felt and compressed against the astragalus, scaphoid and cuneiform bones, between the extensors of the big toe and of the other toes. Here also this vessel may be the seat of a traumatic aneurism, the result of injury generally, but which has sometimes developed after tenotomy.

(2) *By Strangulation of the Limb.*

Special means of arrest. (2) By Esmarch's bandage and tube.

The process generally known by the name of Esmarch's bloodless method consists in first of all emptying the limb of its blood by rolling a long indiarubber bandage from below upwards to the spot where the circulation is wished to be controlled. At this spot a stout indiarubber tube two feet long, with a hook at either end, is passed round the limb, sufficiently tight to strangulate all the vessels, and the ends of the tube are then hooked into each other. (Fig. 8.)

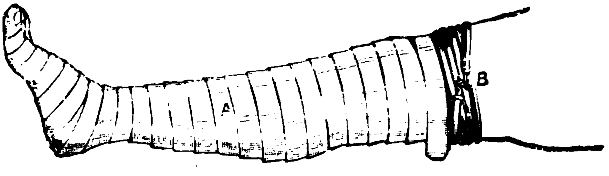

FIG. 8.—*Esmarch's Bandage and Tube applied.*

The indiarubber bandage is then removed, and the limb, thus rendered bloodless, will remain so until the tube is taken off.

This method is simple enough, and with ordinary care all chance of bleeding is prevented. It is especially useful in such operations as the removal of sequestra, scraping or gouging carious bone, etc., where it is important to have the exposed parts as dry and bloodless as possible; but it will also serve in the place of a tourniquet in amputations, or in other cases where it can be applied at some little distance from the seat of operation.

The strangulation by this method is so complete, veins, arteries, and capillaries being all compressed, that it is not safe to allow the tube to remain on long.

Its use therefore is not fitted for the restraint of accidental hæmorrhage, except as a temporary measure, and indeed in some very prolonged operations it is wise to remove the tube before the operation is finished.

When the Esmarch's bandage has been used in an operation, and only general oozing is expected to occur in the wound, it is generally convenient to apply the dressings, using such pressure as may be required, *before* the tube is taken off, for the absolutely bloodless condition of the small vessels has caused a temporary loss of tone in their walls, so that when the blood current is allowed to flow into them again, they for a time are much dilated, the whole limb becomes injected, and unless the wound has already been bandaged up, and pressure applied, there may be a very brisk flow of blood, and a corresponding delay in the dressing. This applies only to the smaller vessels; and arteries large enough to give trouble, should be secured by forceps or ligature before taking off the tube.

There has been latterly an increasing desire to simplify Professor Esmarch's procedure, and to do away with the indiarubber bandage, while retaining the tube. It is found that if the limb be raised and the larger veins emptied of blood by the passage of the hand along the limb towards the trunk, that the latter may be rendered nearly bloodless, and that the application of the tube alone is able to keep it so.

The limb should simply be raised, before putting on the tube, in cases of septic inflammation or malignant growth; as morbid products may be forced into the blood stream if pressure be applied over the affected area.

The tubes used for encircling the limb should always be tested before they are used, for they are very liable to crack or break unexpectedly, especially at the ends where the hooks are fastened.

As a figure of 8.

In cases of operation about the shoulder, or hip, the tube may very usefully be put on in the form of a figure of 8, and in this way even such operations as amputation at the shoulder or hip joints have been rendered almost bloodless. The plan succeeds best where there is much emaciation.

(3) *By Tourniquets.*

Special means of arrest. (3) By tourniquets.

A tourniquet is, properly speaking, an apparatus for screwing down a pad upon a vessel. Practically, however, the term is applied to any means by which pressure may be put upon a vessel and mechanically maintained.

Three principal kinds.

The principal forms, which alone will be described, may be roughly separated into three classes—improvised, screw, and indiarubber or elastic, tourniquets.

The improvised tourniquet.

The improvised tourniquet is an efficient and ready improvement on the time-honoured method of stopping bleeding from any part by tying something round it, somewhere between the wound and the heart, tightly enough to strangulate all the tissues.

In the improvised tourniquet especial pressure is put upon the main artery, and therefore the force required is very much less, and the venous return is at least not wholly obstructed.

Its application.

Its manufacture and application are simple enough. A handkerchief is taken, folded up like a cravat, and a piece of cork or wood, or a pebble, is inserted between the folds, so as to act as a pad. This pad is placed over the artery, and the cravat *loosely* knotted round the limb, the knot coming on its outer side. (Fig. 9.) An umbrella, or ruler, or any moderately strong rod or stick is then passed between the limb and the knot, and twisted round. The leverage thus obtained is very great, and the amount of compression must be estimated, or it may be afterwards found to have been damaging the tissues.

This form of tourniquet is known also by the names of "The Garrot" or the "Spanish Windlass."

Screw tourniquets. Petit's.

Of screw tourniquets, the oldest form which is still retained in use is known as Petit's (Fig. 10).

Its action and method of application can be readily enough seen from the woodcut. The strap is first fastened round the limb, not so tight as to make any compression, but sufficiently to prevent the whole tourniquet, or the small pad of lint generally placed underneath the larger pad, from shifting about.

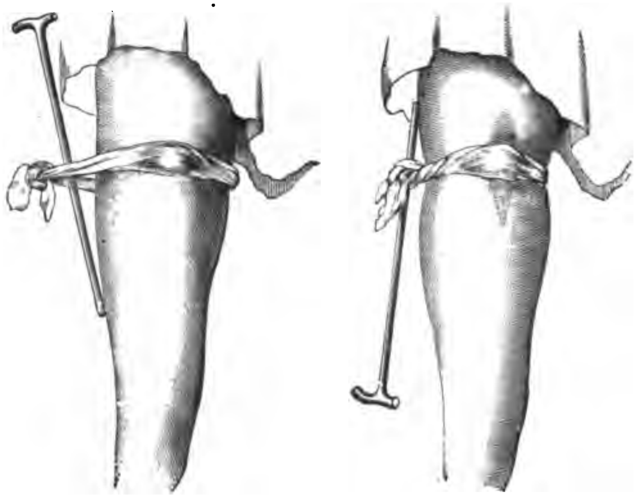

FIG 9.—*The Improvised Tourniquet or "Garrot."*

The tourniquet should be unscrewed to its full extent before the strap is buckled.

When pressure is to be made, the screw must be turned very rapidly, and great care should be taken that the pad never shifts from its position on the artery.

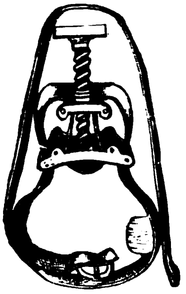

FIG. 10.—*Petit's Tourniquet* (modernized).

It will be noticed that in this pattern, as in the Spanish Its drawbacks.

windlass, in addition to the especial pressure on the artery, the limb is tightly grasped by the strap. In consequence, Petit's tourniquet is very painful, and could not possibly be used for long. But the following screw tourniquets have all been designed to free the venous circulation through the limb, by making pressure only between two opposite points.

Signorini's. The principal forms of these are, Signorini's (Fig. 11), which is easy of application, but is liable to slip round the limb.

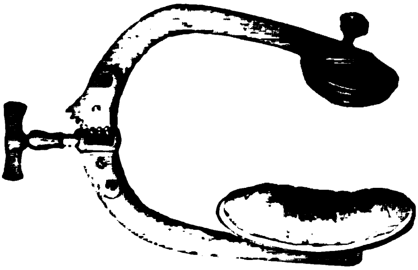

FIG. 11.—*Signorini's Tourniquet.*

Skey's. Carte's or Skey's, (the safest pattern) (Fig. 12), for the vessels of the thigh, and Lister's, for the abdominal aorta.

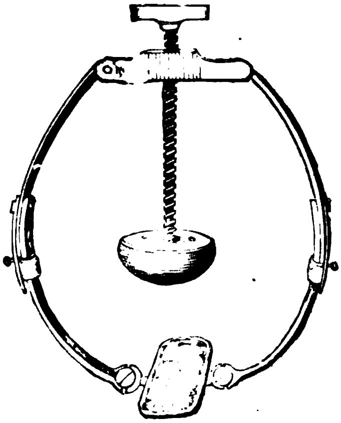

FIG. 12.—*Skey's Tourniquet.*

An effective tourniquet for the subclavian artery is still much to be desired.

With regard to the use of these tourniquets, the localisation of arteries has been sufficiently dealt with; in all the pressure should be made very gradually, and either a small pad or the finger should be placed over the artery itself, underneath the pad of the instrument.

Lister's, for abdominal aorta.

The compression of the abdominal aorta by Lister's instrument is in itself a serious proceeding, apart from the operation to which it is an adjunct. Some, at any rate, of the important abdominal viscera must be appreciably compressed, and it seems impossible to make sure of avoiding such organs as the main branches of the solar plexus, the pancreas, and intestines, injury to which might well cause a collapse even more serious than that which the instrument is designed to prevent.

Its application.

For these reasons this tourniquet is not frequently used now. The best way to apply it is for the patient to lie on the right side, while it is put on and roughly adjusted; in this way the great part of the intestines, etc., escape the risk of pressure. The patient then lying on his back, the artery must be found as mentioned before, and pressure made extremely slowly.

Elastic tourniquet.

In addition to the elastic band used in Esmarch's method, which has been already described, a solid indiarubber cord fitted into a groove in an ebonite or wooden compress may be used. It is portable and readily applied, but is somewhat liable to slip; there are two or three patterns on this principle.

Importance of ligature.

It would be difficult to mention an improvement in the art of surgery greater than the introduction of the practice of tying the mouths of vessels. This was introduced and advocated by Ambrose Paré,* to whom the credit of the advance is due, although he admits the idea was suggested to him by some observations of Galen.

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* Paré, when serving as barber surgeon in the French army in Lombardy, circa 1536, began the practice. In his account he says: "Wherefore I earnestly entreat all Chirurgians that they would (being admonished) give over that cruel and butcherly kind of curation, and practise this which I have prescribed, taught me, as I interpret it, by the suggestion of some good angel. For I neither learned it of my masters, nor of any other man, only I read in Galen, in the first book of his "Methods," that to stay a fluxe of blood, there is no remedy so present as to tie up those vessels that bleed, towards their roots, that is towards the liver and the heart. Now I conceived that this doctrine of Galen's for the binding and sewing of veins and arteries in fresh wounds might well be used in the like vessels after a dismembering, and so I put it in practice."

The methods of ligature.

There are three principal methods of putting a ligature on a divided artery. The first consists in seizing it, and it only, with a pair of forceps, holding it up and tying a cord of some kind round its mouth in a reef knot. (*See* Fig. 15.) The second consists in passing a sharp curved needle in a handle, called a tenaculum, beneath the vessel as it lies in the tissues, and then after raising up the vessel and its surroundings, putting a ligature around all, below the needle, which is itself withdrawn after the knot has been tightly tied.

Filo-pressure.

A third way consists in passing an eyed tenaculum beneath the vessel near its open mouth. The needle may be threaded before or after it is passed, with a catgut or silk ligature, which may then readily be tied over the vessel and the small amount of tissue which will be included in the noose. Thus—

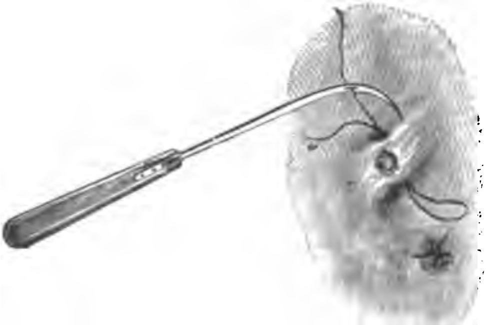

FIG. 13.—*Filo-pressure*—(*after* MACCORMAC).

Forceps

If it is desired to seize the vessel for the purpose of immediate ligature, nothing does better in skilful hands than the common dissecting forceps, with well roughened points, and with no spring to get out of order, but more commonly a special form of forceps is employed, with the points notched so as to fit into each other, and thus to "bite" the artery; usually they have a spring catch to hold the blades together, and on the whole, the most satisfactory pattern is the "fenestrated" of Wakley or Lister.

In catching the vessel it should be taken up as cleanly as possible, with none of the surrounding tissue, and slightly drawn upon. The ligature should then be thrown round the forceps and slipped over the vessel and tied tightly in a reef knot.

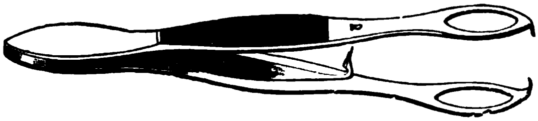

FIG. 14.—*Fenestrated Forceps.*

It is very desirable for the student to get into the habit of tying vessels neatly and quickly. The commonest faults are tying a "granny" instead of a reef knot, engaging the points of the forceps in the noose, and neglecting to keep the two forefingers close to the forceps and vessels. If this last point be well attended to, it will be found best to take the forceps off the vessel after the first part of the knot is formed, but before it is completed, as in this way the knot is more tightly tied.

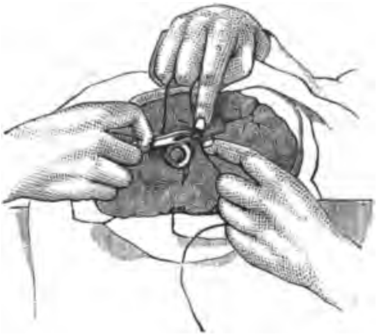

FIG. 15.—*Ligature of an Artery (position of hands).*

Materials used in ligation.

The materials used in ligation are silk, hemp, catgut, and some other animal materials, as kangaroo tendon, ox aorta, etc.

Silk.

At the present time, silk, catgut and kangaroo tendon alone need to be considered. Silk was in former times the most esteemed as being the easiest of application.

Then in later years and up to the present time many surgeons considered it necessary to leave one end hanging out of a corner of the wound until it came away, and this involved risk of septic infection from the fistulous track thus formed. The silk at that time was softer and less twisted than that we use now for ligature, so that it was difficult to make it aseptic, or keep it so, especially when the loose ends of the threads were allowed to project from between the lips of the wound.

Catgut.

At its commencement the practice of making surgical wounds retain their normal condition of asepsis throughout all their healing processes, threw naturally a discredit on silk as a ligature, and though it never went quite out of use, catgut succeeded in taking its place in general usage, and Sir Joseph Lister had convinced the surgical world that with matured catgut, prepared, but not over-prepared, the knotted ends of the thread might be cut quite short in the wound, there to be absorbed in the course of a few days (or at most three weeks).

"Carbolized."

There are two principal varieties of it, both introduced by Professor Lister. The original "carbolized catgut" is made by soaking the gut in carbolic acid and olive oil, in proportion of 1 - 5, with a little water, for some months.

"Chromicised."

The other,* the "chromicized" gut is made by steeping it in a solution of one part of pure carbolic acid to twenty of a 1 - 4000 solution of chromic acid.

The catgut before it is used should be made supple by soaking in a 1 - 40 solution of carbolic acid, and this, if the gut be properly prepared should render it supple only, and not cause it to swell and become flabby.

A good chromicized catgut is nearly perfect as a ligature, but the uncertainty of one sample being like another both in breaking strain and capacity of being absorbed, renders the perfect ligature still a thing to be looked for. Possibly it may be found in the long tendons of a kangaroo's tail, or some similar tendon, where there is great strength and flexibility combined, with a capacity of being absorbed, or partly organized.

During the last few years the manufacture of both ligatures and sutures of silk thread has improved the strength and firmness of the twist or plait, and abdominal operations have proved how well almost all tissue bears the presence of small foreign bodies if they are clean, as silk should be. It is, as a fact, coming back into general use.

Use of the tenaculum.

The same ligature materials are employed for the *tenaculum* as for the forceps, and the instrument itself is extremely useful in picking up arteries in situations such as between, or close to, bones, or in tense bands of fascia, or indeed anywhere where the vessel cannot readily be picked up with the forceps.

Another frequent occasion for the use of the tenaculum is when from any cause there is troublesome hæmorrhage from a vessel, the position of which cannot exactly be made out, or from a small number of vessels, or when a vessel is nicked, but not divided. In these cases frequently the readiest way to stop the bleeding is to push a tenaculum somewhat deeply beneath the bleeding, and pass a ligature round it.

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* See Prof. Lister on the Catgut Ligature. *Lancet*, Feb. 5th, 1881.

Tenaculum ligatures must be tied up very tight, or they will slip. For this reason silk is perhaps better than catgut; at any rate it is more frequently used at the present time.

The bulldog and serréfine.

Two small instruments for arrest of bleeding by pressure may be mentioned here, the "*bulldog*" forceps (Fig. 16), and the "*serréfine*" (Fig. 17).

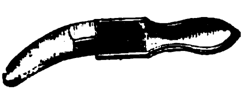

FIG. 16.

"*Bulldog*" *Forceps.*

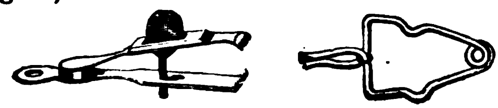

FIG. 17

Two patterns of Serréfines.

They are both "clips," which may be quickly put on to a bleeding point or vessel, and may there be left until, either by the pressure of their springs the vessel has ceased to bleed, or until the surgeon has leisure to ligature it. The serréfine is also used sometimes for the purpose of carefully adjusting superficial wounds in exposed parts, such as the face or neck.

Forci-pressure.

Forci-pressure.—This rather barbarous name more especially designates the use of a pattern of self-closing forceps suggested by Sir Spencer Wells, for the purpose of stopping temporarily the bleeding from small arteries and arterioles in the course of operations upon the abdomen, especially from the divided abdominal walls, to avoid the flow of blood into the peritoneum.

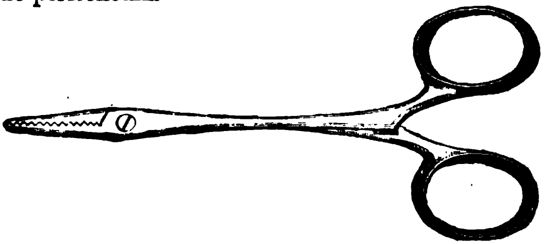

FIG. 18.—*Forci-pressure Forceps.*

They have their bows so fashioned that the first finger and thumb can instantly unfasten the catch on the shanks. Their great usefulness consists in the fact that they can be clipped on to a bleeding point in a moment, as during the course of an operation, and then may be left hanging until the bleeding is arrested permanently by their compression, or the surgeon has leisure to twist or tie the vessel. Much blood and much time are saved by having a good supply of these forceps handy at any operation where bleeding is likely to be free, for they are strong enough to hold a trunk artery, and well enough made to catch any thing smaller, down to an arteriole.

These forceps make also very good sponge or needle-holders, and should be in every dresser's pocket-case.

Torsion.

In machinery accidents, where a limb has been very badly injured, or it may be, completely torn from the body, it generally happens that there is little or no bleeding from the large arteries divided across; and if these are examined they may often be seen pulsating quite down to their extremities, which yet are as firmly closed as if they were ligatured.

Its principle.

The explanation is that the vessels have been *pulled* asunder, and that in this pulling, the two inner coats have first parted, while the external coat has only yielded after considerable extension. The aperture of the tube is therefore narrowed before it finally gives way, and the vessel comes in two. The outer coat afterwards retains its narrowed condition, and the elastic ones inside retract. These inner coats therefore will be thickened to such an extent that their sides will come into contact within the narrowed outer coat of the vessel, and will effectually close it up.

Its history.

The properties thus possessed by the coats of the vessels were first applied to their artificial closure when divided, by Amussat, in 1829, and soon afterwards by Velpeau, since whose time it has been known as the method by "Torsion."

In this proceeding the vessel is not pulled asunder, but the end is twisted round many times. The inner and middle coats are thus broken across, and by retracting become thicker, as above described. The narrowing of the outer coat of the vessel is effected by the continuous twisting. Mr. Bryant, in 1868, advocated strongly the advantages of torsion, giving 200 consecutive cases of amputation in which the main artery was twisted without a single case of secondary hæmorrhage.

For small vessels it is only necessary to seize the vessel fairly with "Torsion forceps," and to rapidly twist the end round and round six or eight times, but for large vessels the operation requires more care. The vessel should first be separated from its sheath and pulled out of it for about one-third of an inch. At the point of its exit from the sheath it should be held with a pair of narrow forceps, and then, its end being held in the torsion forceps so as to leave as much as possible of the artery free for twisting, this should be quickly done, the forceps being held parallel to the long axis of the vessel.

Its practice. Free torsion

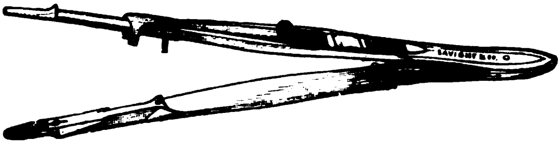

FIG. 19.—*Torsion Forceps.*

Limited torsion.

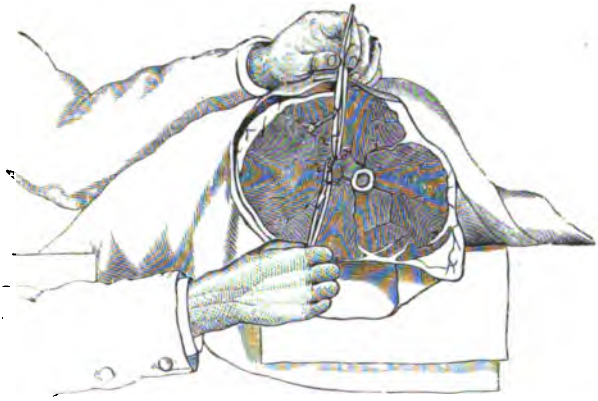

FIG. 20.—*Method of Torsion.*

Some surgeons twist the vessel until the part in the forceps comes away; others give six or eight turns only, probably the preferable plan.

For this treatment to succeed, the arterial coats must be free from disease, such as atheroma, or those more insidious forms of arteritis present in chronic syphilis, gout, etc. When first introduced in the days of the old silk ligature, the advantage of having no foreign body hanging out of

Vessels must be healthy.

the wound was very great; nowadays the twisted end of the vessel is in just the position of a catgut ligature cut short: both in healthy wounds will be absorbed, and neither can be regarded strictly as foreign.

Acupressure

In a similar way "acupressure," when first introduced, was hailed as a great advance on the older silk ligature, but at the present time the occasions on which its employment is especially advantageous are becoming more and more rare; while except in the case of exposed wounds there is this constant disadvantage, that opposing surfaces can hardly be brought together for union by first intention, when needles are used.

The essence of the procedure consists in the passage of a stiff steel needle through the tissues in the neighbourhood of a vessel, and then to arrest the bleeding by its pressure, either on the tissues *in situ*, or when twisted round, or by passing the needle in below the vessel and passing a loop of wire or silk over it, the vessels being included between the two.

The needles should be withdrawn between twenty-four and forty-eight hours after their insertion. If the loop of silk or wire be used, the needle must be drawn out first, and the loop will then be free.

For further details on this method, which at one time was worked out with great elaboration, the student is referred to the surgical writings of Professor Pirrie, of Aberdeen.

For wounds about the face, and wherever great accuracy of coaptation is required, and notably about the mouth, a form of acupressure is employed which serves the double purpose of arresting bleeding, and adjusting the edges of the wound. This will be treated of in the section on wounds. (See hare-lip pins.)

Deep sutures.

Another useful method of stopping bleeding in certain cases is also allied to this principle of acupressure, namely, the passage of sutures of stout silver wire through or beneath the bleeding part. The reader will readily imagine cases in which this proceeding would be of avail; but, as an instance, the common practice of leaving to the sutures the office of stopping the numerous small vessels that are divided in the edges of amputation flaps, may be adduced.

CHAPTER III.

OF CERTAIN SPECIAL KINDS OF HÆMORRHAGE AND THEIR ARREST.

Hæmorrhage from an imperfectly divided vessel.

From an imperfectly divided vessel. If this form of bleeding be not efficiently arrested it is always troublesome, and sometimes even dangerous. It most commonly occurs on the scalp, or from a wound in the cleft between two fingers, or from the artery of the frænum. Again, when the transfixion method of amputation was more common than it is now, the vessels were apt to be split, instead of being cleanly divided by the knife. This was a frequent cause of secondary hæmorrhage.

The bleeding is obstinate, because the process of its natural arrest is interfered with; for the cut edges of the wound in the arterial coats retract as far as they can, and this retraction keeps open the orifice in the vessel, instead of tending to close it. The tube thus being only half cut across cannot retract its ends within the sheath as it is wont to do when completely severed.

From a digital artery.

In all cases the thing to do is to enable the natural arrest to go on by completely dividing the vessel. In the case of an *imperfect division of a digital artery* between the fingers, the bleeding is sometimes very troublesome. In such a case the vessel should be cut down upon and carefully exposed without injury to the neighbouring nerve trunks. A ligature should be placed above and below the wound in the vessel, and then it should be divided. An Esmarch's bandage previously applied will make the dissection more easy; the dressing should be put on, and the fingers tied together before the indiarubber band is removed.

From the artery of the frænum.

The artery of the frænum of the penis is sometimes ruptured during coitus. If it be torn right across the bleeding is slight, but if only half divided it is sometimes very profuse. In this case all that is necessary is to divide it completely with a pair of scissors, and then to apply moderate pressure.

From a scalp wound.

Wounds of the scalp often bleed very freely, especially at first. In dressing them the hair should be cut off all round the wound, which itself should be well washed. Even if the spouting vessels are plainly to be seen, it is almost always waste of time to try and pick them up for the purpose of ligature. A good firm compress, secured with a knotted bandage, will, by ensuring pressure against the underlying bone, arrest any ordinary hæmorrhage. If a vessel *must* be ligatured in the scalp tissues, it will most easily be done with a tenaculum, or by the methods of filo- or forci-pressure (pp. 22 to 25); and it is best to use a piece of strong silk.

From the palmar arch.

Wounds of the palmar arch are very troublesome, and the bleeding from them is very apt to recur. This is due partly to the vascularity of the parts, and partly to the difficulty of applying efficient pressure, the vessels themselves lying beneath, and protected by the thick bands of the palmar fascia.

Although it is difficult to apply pressure, in most cases it is necessary to do so, for other means would tend to cripple the mechanism of the muscles and tendons of the palm. Sometimes no doubt it is advisable to dissect out the bleeding vessel in this crowded region, and put a ligature on it, but as a rule, the hazards of this proceeding outweigh its obvious advantages.

In applying pressure to the palm of the hand, a firm smooth pad must be used, and the palmar fascia must be relaxed. These two conditions are well fulfilled by bending the fingers over a round piece of wood, like a ruler, covered with three or four layers of lint, or over a tight roller bandage. If this be firmly grasped, and the fingers bandaged over the cylinder, very good pressure will be made. (See Fig. 21.) Should the bleeding still continue, the forearm should be

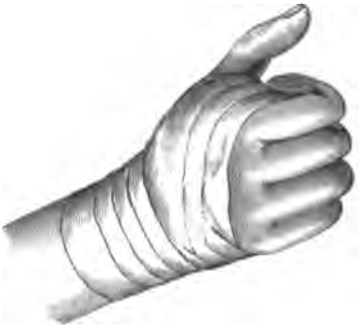

FIG. 21.—*The Hand bandaged for a Cut in the Palm.*

forcibly flexed at the elbow, with or without the addition of a pad of lint in the flexure of the joint. This will almost always stop the bleeding, but should it fail (and it is wonderful how this form of bleeding will persist) it will be necessary to compress the radial and ulnar arteries at the wrist. This is best done by laying two pieces of wood, *e.g.*, portions of a lead pencil, over two small pads placed on the arteries, and fastening them firmly with strapping, the hand, forearm, and arm being firmly bandaged from below upwards.

But it may happen that even yet the bleeding recurs, and by this time, as several expedients have been fruitlessly adopted, the patient may be getting exhausted by loss of blood. A tourniquet or digital compression of the brachial artery can be a temporary expedient at any stage of the proceedings; but this cannot be kept on for long, especially in this exsanguine condition of the patient. The course usually recommended in books is to tie the radial and ulnar arteries at the wrist, but if pressure has been properly applied and has failed, it is hard to see how ligature can have happier results.

On the whole the best plan seems to be, first of all to open up and thoroughly examine the wound, and if it appears feasible by dissection, to find, and tie the bleeding vessel or vessels, and failing this, to tie the brachial artery, high up in the arm—a somewhat desperate remedy truly, and one which can very rarely be required if the milder measures before mentioned have been thoroughly carried out.

It should be borne in mind that the tourniquet can always be put on for an hour or two, so that the visiting surgeon can be sent for; and also that bleeding so obstinate as this may probably be associated with a morbid condition of the blood or its vessels. (*Vide* Hæmorrhagic Diathesis.)

Hæmorrhage from canalised vessels.

Vessels, either veins or arteries, may be so connected with the surrounding tissues, that when divided, their walls neither contract nor retract. Their mouths are thus kept open and they are said to be *canalised.*

Entrance of air into veins—danger of.

Thus the jugular and other veins at the base of the triangles of the neck, are so bound down by the cervical fascia, that if they are divided, and especially if divided in the angle of a wound, they gape and bleed. This is especially dangerous in this situation, not from the hæmorrhage, but from the danger of entry of air into the blood current going to the right heart.*

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*See Chapter XXVIII.

Other difficulties of.

But canalised vessels may give trouble in other situations besides the root of the neck, especially at the angle of a wound held open by its gaping, in tissues the seat of fibrous thickening or chronic inflammation, or when vessels, themselves atheromatous, are inelastic and rigid.

At the angle of a wound.

For vessels at the *angle of a wound* the best way is to extend it slightly, when they will retract. But those running through *tissues, the seat of chronic inflammation* are often troublesome, as in amputations for long-standing disease, when almost every vessel, insignificant though its size may be, requires a ligature, because it will not retract.

In diseased tissues.

Artheromatous arteries.

This also is the case with *atheromatous arteries*, but there is this additional difficulty, that because of the disease of the arterial walls, a ligature is very apt to cut through, so that great care and well softened ligatures will be required.

Ruptured varicose veins.

Bleeding from *a burst varicose vein* is often one of the most furious, and yet one of the most easily arrested of hæmorrhages. It is important to rightly understand it, for many lives are thrown away every year in consequence of the foolish unreasoning conduct of would-be assistants, when this accident happens.

No one can be long in a hospital casualty department, without seeing some such case as the following. A man who for a long time has had varicose veins, and subsequently a condition of chronic eczema and ulceration of the legs, stupified by cold or drink, subjects the legs to some slight violence, so slight that often it is hardly noticed. Presently he is aroused to the sensation of something warm trickling down the ankle, and looking down he sees his boot and stocking full of blood, which is coming from the position of the ulcer. He then becomes faint and falls. A crowd collects, and (the prone position on the ground being the safest for him) they immediately lift him and try to make him sit up. They then get some brandy, and proceed carefully to choke him, while he is unable to swallow.

A bystander then sees the blood tricking along the floor or ground, and so he takes his handkerchief and ties it tightly somewhere round the leg, which is still allowed to hang down. The patient being then put into a cab, is driven off to the hospital, perhaps to die before he gets there, as the blood is escaping from his leg all the time.

All this might have been easily avoided by the exercise of common sense. Since the recumbent position is the best for syncope, the patient should not be raised from the ground until a suitable stretcher is provided. Then, the leg being raised a foot or so, the bleeding surface should be exposed, and any constriction round the limb on the "heart" side removed. In all probability the bleeding will practically cease immediately the limb is raised, and a small pad and bandage being placed on the wound, it will not recur while the patient is lying down.

It should be remembered that the blood comes principally from the proximal end of the ruptured vein, the valves of which have been rendered incompetent by the dilatation.

If however, the patient *must* walk soon after he has had a burst vein, the leg and foot should be firmly bandaged from the toes upwards, to a little above the bleeding point, on which there must first have been placed a pad and bandage. It is also necessary to keep the patient warm; the loss of blood is often very great, and such patients cannot bear it well, so that it sometimes happens that after the bleeding has been stopped, they get a sudden failure of the heart's action, and die because they have been allowed to get too cold.

From the nose—its varieties.

Nose bleeding is either idiopathic or traumatic, and is venous and capillary in character. It is of all kinds and degrees of severity, and may require for its arrest a number of expedients, some very simple, some requiring considerable skill.

When to be left alone.

But it is often desirable not to check the bleeding at all, as when it occurs in children in good health, and young adults of a lusty habit; or in some cases in young women in whom the hæmorrhage is vicarious to the menstrual flow.

If idiopathic, may be active or passive.

Idiopathic epistaxis may be roughly divided into two classes; the one in which it depends on simple congestion of the mucous membrane of the nose, occurring in healthy people, and the other in which it is a strictly passive congestion, caused by cardiac or hepatic disease.

Danger of latter form.

The hæmorrhage in the first class tends to stop of itself, when by the bleeding the congestion is removed; but in the second the cause is constant, and the longer the epistaxis goes on, the more difficult it is to stop, in consequence of degenerative changes taking place in the blood. The bleeding in these cases is not a brisk flow accompanied with a good pulse and other signs of a strong circulation, but is rather a feeble dribbling, sometimes stopping altogether, and then being again a little more rapid. In this way a great deal of blood may be lost by those who cannot spare it, and the bleeding, instead of being a relief, is accompanied by great depression, a feeble fluttering pulse, shallow respiration, etc.

A little experience of the aspect of sick people will enable the student to recognise those who are suffering from visceral disease, whether it be morbus cordis, or cirrhosis of the liver, or chronic Bright's disease, or a malignant growth, and to sharply separate in his own mind those in whom moderate epistaxis is rather a relief, from those in whom it is certainly an alarming symptom, and may be a source of danger. In these latter it should always be promptly checked; in the former, delay is never hurtful and may be useful.

The expedients for checking epistaxis are very numerous, and are best described in order of their importance, and as in practice they should be employed; the simpler measures being always tried before those which cause discomfort or pain.

Position.

In the first place, *position* is as important in these cases of bleeding as in any other.

The patient's head should never be bent down over a basin, nor should the circulation be stimulated by his remaining standing. The best position is the sitting one, with the head thrown back. A towel spread in front like a bib will prevent the clothes being soiled, and moveover will obviate that constant blowing and wiping of the nose, which is most harmful.

If, in addition to this position, the venous return to the chest be promoted by everything being made quite loose round the neck,* in very many cases nothing further need be done, and an epistaxis, which has perhaps lasted two or three hours while the head was held down over a basin, will stop in as many minutes.

If it still persists the next thing to do is to raise the arms above the head, or to rest the hands on the top of the head. This has a very good effect, probably by increasing the chest capacity, and thus lowering the intra-thoracic blood pressure in the right heart and the large venous trunks.

Application of cold.

The application of *cold* externally is the next expedient. Ice, or a cold evaporating compress is recommended to be put over the bridge of the nose, but it is very doubtful, if there, it does any good. But cold applied to the *nape of the neck*, undoubtedly, is a very powerful agent for arrest. Slipping a door key down the back is therefore no mere superstition, but good effects are better secured by an ice-bag fastened over the upper cervical spine.

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* It may be worth while to remind the reader that the collar of the jersey may be tight, while that of the outer shirt looks quite loose. In the case of women it is also wise to loosen the stays.

Local applications.

If these measures have failed, we must proceed to more vigorous ones in the form of local applications to the bleeding part, by means of a syringe or nasal douche, by an astringent powder, or by plugging.

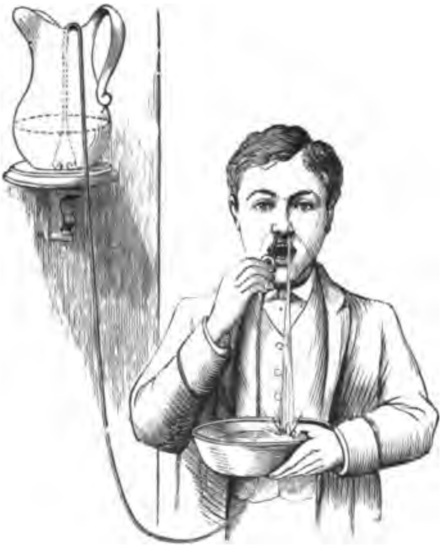

FIG. 22.—*Nasal Douche.*

Syringing.

The nostrils may first be syringed out with iced water, using a common syringe, or better, one of Higginson's pattern, or a nasal douche (Fig. 22). In using the latter, the water should be forced into one nostril, so that it can flow round the posterior nares, and come out at the other. This is effected by keeping the mouth wide open and the soft palate therefore raised.

Instead of iced water, a weak solution of perchloride of iron, say one to two drachms of the liq. ferri perchloridi, to a pint of water, or of the sulphate of iron, or of alum in similar proportions, may be advantageously used.

Alum and tannin.

Epistaxis may be checked also by the use of solid astringents, as powdered alum or tannin, used as snuffs. The powder, when placed in a paper, folded so as to make a trough, is "sniffed" strongly up the nose. This is a very irritating and disagreeable proceeding, and is not to be recommended if other means of arrest are at hand.

Plugging.

In cases of continued failure, we fall back on the last resource of plugging the bleeding nostril; for digital compression of any external artery is obviously useless, and compression of the nostrils can only be useful in very superficial hæmorrhages, and these are not common.

The nostrils may be plugged, either from the front alone, or by completely shutting up the nasal cavity on one or both sides, by plugging the posterior as well as the anterior nares, or by means of a nasal tampon or inflating bag.

By the anterior nares only.

Plugging from the front alone. If this operation be thoroughly performed, it will not often be necessary to resort to the disagreeable and not altogether safe practice of plugging the posterior nares. To plug from the front, a strip of lint, at least 18 inches long, and a third of an inch wide, and a stiff director are required. The strip may be dipped in perchloride of iron solution, or in carbolic oil, if it is thought desirable (the latter is very useful to prevent decomposition), and must then be packed right back to the posterior nares, and the full length of the floor of the nose must be borne in mind.

The back part being well filled, the more accessible parts of the cavity are plugged easily enough, the strip of lint being gradually coiled away until the whole nostril is full.

Plugging the posterior nares.

To plug the posterior nares, a "Belloc's sound" or some substitute for it, will be required, and two suitable little plugs fashioned to fit the anterior and posterior nares respectively. They are best made of lint, tightly rolled, so as to make two cylinders about an inch long, and half an inch wide. The one which is to go into the posterior nares, must be tied round the middle with a piece of string, so that two ends, not less than a foot long, hang from it in front, as in the figure (Fig. 23), while another piece, not shown in the illustration, should be fastened to it behind, so that when the plug is adjusted into the posterior nostril, this may lie in the pharynx, ready to be brought forward out of the mouth when the plug has to be removed. These being ready, the sound, consisting of a cannula, within which is a piece of watchspring, which will curl round the soft palate into the mouth on being pushed out of the tube, is introduced along the floor of the nostril which is bleeding. The watch spring is protruded, and is hooked forward by the forefinger of the left hand, into the mouth, and *both* ends of

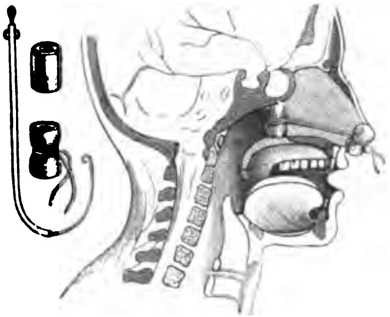

FIG. 23.—*Section through the head, showing Nasal Plugs in position with Belloc's sound.*

the string, which are attached to the plug of lint, are quickly passed through the eye, which will be found at the end of the watchspring. This is then retracted into the cannula, and the latter, when withdrawn through the nostril, will carry the strings with it.

The strings must now be separated from the cannula, and drawn through the nostril. The plug will thus be drawn into the mouth and carried backwards to the soft palate; it must then be passed behind this with the fingers, and pushed upwards into the upper part of the pharynx, and traction being made on the strings, it can be adjusted by the fingers, to fit into the proper opening of the posterior nares. This being done, the other plug is adjusted into the anterior nostril, *between* the ends of string, which are firmly tied over it and fasten it tightly to the nostril, which is thus converted into a shut cavity.

The principal difficulties in this plugging operation are, first, the introduction of the sound, and the bringing forward of the watchspring, and secondly, the adjustment of the posterior plug. It is often awkward to pass it round the soft palate, but this being done, the rest is easier. Still it is not difficult to mistake the opening into which the plug is to be placed, and to avoid this, the fingers must be passed right back, and the nostrils thoroughly explored.

If a Belloc's sound cannot be got in an emergency, an improvised one may be made from a soft gum elastic or rubber catheter, about No. 6 to 8. Passing this through the nostril, it can be hooked forward from the pharynx out of the mouth, the strings attached to the posterior plug must then be fastened to its end, and the catheter withdrawn through the nose, with the same manipulation of the plug round the palate as before described.

Difficult as the application of these plugs may be, once applied, it is impossible for bleeding to continue. Unfortunately, it is not safe to retain them in position long, 36 hours being probably the outside limit; necrosis of the palatine bones, extreme fœtor, and blood poisoning being apt to occur.

By an inflating tampon.

Inflating tampons are sometimes used to arrest epistaxis by filling the nasal cavity with a blown out indiarubber bag of a suitable shape, the principle being the same as that of a "Barnes' Bag" for uterine hæmorrhage. Of these "Cooper Rose's Inflating Plug" is perhaps the best pattern; it is figured on page 43 (Fig. 24).

Special forms of epistaxis.

In fevers.

There are two forms of epistaxis which are not very uncommon in medical practice. The first is a rather brisk attack, and comes on at a critical phase of some acute fever, such as a pneumonia. In such an illness it not infrequently happens that about the sixth day an attack of epistaxis comes on, and coincidently the temperature falls, the pulse slows, and other symptoms of defervescence are manifested. This epistaxis may truly be called "critical," and may be compared with the profuse sweating or diarrhœa which often heralds a crisis.

The necessity for checking this bleeding will vary in each case, and no general rules can usefully be laid down. At first, at all events, it does not call for active measures. The condition of the pulse will be the best guide as to when such interference is required.

In exhaustion.

The second form resembles the first, in that it occurs in the course of a severe illness, but in this point only, for it is a sign of a well nigh hopeless condition. It is due to a general breaking down of capillaries, as in purpura. It is associated with bleeding from the gums, the formation of bullæ containing blood-stained serum, and with ecchymoses. It seldom calls for any special treatment.

Bleeding from the socket of an extracted tooth.

It is very rarely indeed that *the socket of an extracted tooth* bleeds to any troublesome extent, considering the enormous number of extractions performed. When it does happen, it is almost always in patients who are either in very feeble health, or else who are affected with some form of the hæmorrhagic diathesis, or scurvy.

Sometimes, indeed pretty frequently, the socket of the tooth goes on bleeding for some hours, in consequence of the nutrient vessel being unusually large or unable to contract. In such a case the bleeding comes from one or two points, and it is not at all dangerous. In the really serious cases, from the whole gum and lining of the socket there appears a general welling up of blood, and this is sometimes hard to check. An "alveolar tourniquet" has been invented for the purpose, but it is now hardly ever used, and reliance is placed on conscientious plugging, and the actual cautery.

Plugging.

In plugging, lint or cotton wool is generally used, either plain, or dipped in some styptic, such as turpentine, carbolic acid, creasote, or alum. In any case it must be packed away very firmly indeed, filling the whole socket, and a little more, so that the plug may be kept in proper position by the opposite tooth, if the jaws be closed with a four-tailed bandage.

Another plan is to *replace the extracted tooth,* if it has been kept, as this often answers very well, as does also a plug of gutta-percha, moulded and pressed into the gap. Every surgeon, however, may come across cases in which the repeated hæmorrhages are endangering the life of the patient, from even such a trivial cause as this. These extreme cases will generally be found to be associated with well marked hæmorrhagic diathesis, and in many cases constitutional treatment has been found a most important accessory to local measures. Probably of these latter, some form of the actual cautery will be found the most useful, the ligation of the common or external carotid artery merely adding another bleeding wound, and being in fact invariably followed by death.

Actual cautery.

Hæmorrhage from rectum.

The bleeding which proceeds *from parts inside the rectum* which can be seen, or felt with the finger, may here be considered. This may be due to simple congestion of the mucous membrane, piles, fissure, *prolapsus ani,* the passage of some hard body, ulceration of the surface of a growth (usually malignant), or dysentery; or it may be the result of the division of some vessel or vessels in the course of an operation.*

From simple congestion.

Hæmorrhage from simple congestion. This occurs in consequence of the turgidity of the hæmorrhoidal plexuses, which is in its turn due to obstruction to the portal circulation.

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* Rectal hæmorrhage may occasionally be vicarious to suppressed menstrual discharge.

The portal obstruction may take place in the liver itself, and may be due to temporary or permanent changes there, or in the lungs or heart.

As in the case of epistaxis, bleeding from this source is often a great relief to the circulation, and is sometimes imitated by the application of leeches to the anus. It hardly ever requires treatment, unless it be desirable to increase the flow, which may be done by sitting in a bath or tub of warm water. Usually the bleeding stops immediately the congestion is relieved, but if it be desirable to arrest it, an enema of thin starch, with 20 to 30 minims of laudanum in it, or an injection of cold water, or of any of the astringent fluids mentioned under epistaxis, will be all that is required.

From piles.

Piles must be looked upon as being due to an extension of the same morbid processes which cause simple congestion of the mucous membrane. Only those which are covered entirely or partially with mucous membrane (internal piles), ever become so turgid with blood as to bleed. These, however, may do so very profusely, and even dangerously. The bleeding usually occurs when the patient is on the stool, and up to a certain point may relieve the portal circulation. It not infrequently, however, becomes necessary to arrest it without loss of time, for it belongs to that form of hæmorrhage which manifests itself as frequently recurring losses of blood, no one of which is of consequence, but which, collectively, are very important. The preventive treatment must be both local and constitutional. The bowels should not be allowed to become confined, but the motions kept pulpy by early morning doses of the confection, or syrup of senna, or with the confection of sulphur, or some saline. Very careful dieting and a good deal of lying down are advisable, with warm light clothing, and in women the removal of stays or anything which compresses the body. Cane chairs, too, are better than upholstered ones.

Constitutional management.

Local management.

Locally, the piles must be returned at once when they come down, and the opportunity may be taken to smear them over with the ointment of galls and opium (P.B.). A continuous douche of cold water from an enema syringe is very useful, as also are astringent injections of iron, alum, etc. Another very commonly used injection is made by dissolving a drachm of alum in a pint of the decoction of oak bark.

By douche.

If on the other hand, the bleeding is important from the actual quantity which is being lost at the time, it will be

Ice. **Plugging.**

found not difficult to stop. An ordinary astringent injection should be tried first. If it fail, the rectum should be cleared out by a thorough syringing of ice-cold water, and then a suitable lump or two of ice may be introduced, and pushed tolerably high up, the patient lying in bed lightly covered, and with the buttocks raised on a pillow. This will generally arrest all bleeding, and then a morphia or opium suppository may be inserted. This treatment hardly ever fails to arrest the bleeding, but if it should continue recourse must be had to plugging. This may be done with sponges, or with the "petticoated plug," as will be described directly, or with the contrivance known as a "Barnes' Bag" (Fig. 24), which was introduced for dilating the *os uteri*, or for controlling hæmorrhage from its cavity, and which is a somewhat dumb-bell shaped bag of indiarubber, which can be introduced while collapsed, and then blown out so as to produce efficient pressure. Again, if the patient be in a fairly good condition for operation, the hæmorrhage may be stopped, and the pile cured by an operation for its removal —that one being chosen which gives the least shock.

From mucous membrane of anus.

The mucous membrane of the anus, partially strangulated as it is when prolapsed, frequently bleeds. It, however, readily stops by returning the prolapse, and syringing the part well with cold water, or with alum and oak-bark lotion.

The passage of hard or rough bodies.

The passage of something hard, or rough, or pointed, such as a cherry stone, a fish bone, etc., is often enough not attended by any trouble until the rectum is reached, and then in consequence apparently of the greater expulsive force employed, the mucous membrane gets torn or scratched, and bleeding occurs. This is very frequent in children, and is easily checked by throwing a little cold water up the rectum. Although the bleeding is of little moment there is good reason for holding that fish bones or splinters do sometimes, by burrowing, or being forced out of the rectum, cause fistulæ.

From ulceration of growth in rectum.

The ulceration of a *growth within the rectum* is generally associated sooner or later, with serious hæmorrhage. These tumours are generally malignant, and in the later stages of their growth, the constant drain, by repeated bleedings, may be the immediate cause of death. In treatment, the principles must be the same as for internal piles, with the addition that the effect of preparations of opium, as local applications, is often very striking.

From dysenteric ulceration.

The restraint of hæmorrhage from *dysenteric ulceration* of the rectum hardly comes within the province of the surgeon's work; but inasmuch as the locality of the bleeding may be the same as that of losses of blood requiring treatment on strictly surgical lines, it is here mentioned. The loss of blood in this disease, when itself a cause of danger, is generally combated by starch enemata, to which should be added laudanum, or a similar preparation of opium, or by morphia suppositories.

From division of large vessels

Bleeding from the rectum, in consequence of *the division of large vessels*, is extremely rare as a result of an accident; but it is common enough in the course of operations, such as those for fistulæ, internal piles, or during the larger planned operations for removal of portions of the gut.

For practical purposes the rectum may be divided into a safe and a dangerous region, so far as the use of the knife is concerned. The *safe* region is the last two-and-a-half inches, the blood vessels in which, though very numerous, are all of them small, being the terminal anastomosing branches of the six hæmorrhoidal arteries.

The *dangerous* region is all the rectum that can be reached, above the place (three inches from the anus) where the superior hæmorrhoidal branches, about six in number, pierce the muscular coat, and lie between it and the mucosa. These vessels are of a considerable size, and bleed very freely when injured.

Bleeding, then, from the lower part of the rectum, after any operation, although at first often brisk enough, speedily stops; in this situation moreover, pressure can be easily applied, or, if necessary the vessels may be tied.

But the case is very different if one of the vessels higher up in the gut has been divided, especially if the parts have been the seat of inflammation which has indurated the tissues and has thus caused them to keep patent the mouth of the vessel, for the situation and warmth favour a rapid flow of blood, while it is very difficult to get any exposure of the part.

The hæmorrhage can always be temporarily stopped by the pressure of one finger; and, indeed, pressure and plugging will in most cases be the procedure resorted to in the end. Nevertheless, if it be possible to get a ligature round the vessel, either with a tenaculum or forceps, a great deal of trouble will be saved. The surgeon should remember that by a free division through the sphincters, transversely across the ischio-rectal space, he may safely let a flood of light upon the scene, provided, of course, that there are no internal piles or other hindrances in the way. The sphincters will readily heal, and the incision will be amply justified, if by its means a ligature has been placed on the vessel.

If this cannot be done, however, and syringing and placing ice in the neighbourhood of the bleeding have failed, then the rectum must be plugged. This may be done with a "Barnes' or Petersen's Bag" (Fig. 24), as for bleeding piles, but this is not so effective in the case of arterial, as in that of venous bleeding; a better way is to use sponges, somewhat compressed, and with a string tied round each one, or passed through them all, so as to provide for their recovery. But the best way of all to plug the rectum is to use a "petticoat" (see Fig. 25), the shape and object of which is rendered sufficiently obvious by its name. The space between the petticoat and the central stick or piece of catheter, is filled with lint, or better, with cotton wool, the plug having been previously put into position in the rectum.

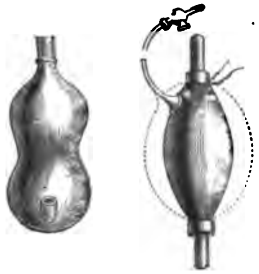

FIG. 24.—*Barnes' Bag and Rose's Tampon (used also for epistaxis).*

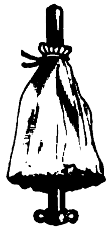

FIG. 25.—*Petticoated Plug.*

From the genito-urinary tract.

Hæmorrhage from the genito-urinary tract. As might be expected, many morbid conditions of the renal tissue are associated with loss of blood. But the treatment of hæmorrhage from the kidneys or ureters is not here considered.

Into the bladder.

Hæmorrhage into the bladder, if serious, is generally due to the presence of a new growth, but a calculus, or a purpuric condition may cause it, or it may be traumatic. In any case the bleeding comes distinctly under the surgeon's care, and calls for active treatment. Bleeding from the prostate again, is not uncommon and may require to be promptly dealt with, but in the majority of cases it is simply congestive, and stops when that condition is relieved.

Generally speaking, in any of these cases, rest and the relief of all congestion in the neighbouring viscera, as by clearing out the rectum, will prevent hæmorrhage into the bladder or from the prostatic vessels assuming a serious character. But if in consequence of the vascular nature of a new growth, or from some similar cause, important hæmorrhage should occur, it will be found to be somewhat difficult to treat. *Locally,* ice may be applied to the perinæum and hypogastrium, or inserted into the rectum, or an enema of iced water may be given. The indications for *internal* treatment generally point to the employment of such styptic drugs as turpentine, tannic acid, or lead acetate with opium, (and Ruspini's styptic has been found very useful in these cases). If the bladder becomes distended with blood clot, it may happen that the urine is retained. In this case a large catheter, such as is used in lithotrity after Bigelow's plan, should be introduced. After the clots have gently been broken up, the catheter should be connected with an aspirating apparatus (Clover's or Bigelow's) by means of which enough clot may be removed to allow of the passage of the urine, and with this relief the surgeon should be content.

Local treatment.

Internal treatment.

Management of bladder when distended with blood clot.

From rupture of the corpus spongiosum.

The question of the management of *rupture of the urethra* will be considered later. In all ordinary cases the bleeding although it may be rather free at first is easily arrested by rest, and cold to the perinæum. But a very furious bleeding into the urethra may occur in consequence of *rupture of the bulb* or corpus spongiosum from external violence; in these cases the blood pours from the erectile tissue and escapes from the meatus urinarius at a rate which will quickly exhaust the patient unless it be arrested. Pressure is the only means of arrest, but pressure here is very difficult to make effectually; the best way is to pass a full-sized catheter and to make compression in the perinæum upon it, at first digitally and later by a pad and bandage.

Bleeding from granulation tissue.

Bleeding from granulations occurs when they are injured, even when absolutely healthy, and may then readily be stopped by pressure. But if the granulations spring from the base of a hæmorrhagic ulcer, or in wounds or sores in patients who are extremely feeble, or who are scorbutic, the hæmorrhage sometimes is difficult to arrest. In these cases, as in others, the sheet anchor of treatment must be pressure, but much may be done by constitutional treatment* and stimulating lotions, such as Lotio Arg. Nitratis grs. v to x to ℥j of water, Lotio Zinci Sulph. grs. iv to ℥j of water, etc.

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* Vide the "hæmorrhagic diathesis," p. 50.

A treatment which is very frequently successful is to *scrape* the granulations completely away with the edge of a scalpel, or with a "Volckman's spoon," such as is used for the eradication of lupus. Another good plan is to apply Esmarch's indiarubber roller, without the strangulating cord, to the whole limb, including the bleeding sore, for not more than 24 hours. Or, finally, recourse may be had to cauterisation with fuming nitric acid, or with the actual cautery.

Hæmorrhage from sloughing phagedæna.

That extremely rapid form of destructive inflammation, known as *sloughing phagedæna or hospital gangrene*, will be considered later; here it must be mentioned only as being sometimes a cause of hæmorrhage which is peculiar, inasmuch as in the manner of its invasion of the tissues, it resembles the course of a malignant ulceration, and does not spare the blood-vessels, but affecting their coats may cause the most furious bleeding.

Vessels may of course frequently be destroyed by ulceration without bleeding, from previous obliteration of their lumina. It is therefore in the most rapid forms only of this disease that bleeding takes place; this is also true of a hæmorrhage from a somewhat similar cause, namely, that which is due to the destruction of large vessels by the formation of abscesses in dangerous regions. In such cases bleeding would be far more frequent but for the fact that time is given for the plugging of the vessels. It does however occur.*

When, therefore, in a case of hospital gangrene, the disease invades the neighbourhood of a large vessel (*e.g.*, in sloughing phagedæna of the groin), the greatest watchfulness must be exercised, and some form of tourniquet be ready to be instantly applied if the vessel gives way, so that time may be gained to send for assistance.

It is often very hard to decide upon the best means to adopt for the permanent arrest of this form of bleeding. If the vessel be small the thermo-cautery or nitric acid may be sufficient, but if it be a main trunk, it must be ligatured, and in that case the surgeon will have to choose between the difficulties of securing a vessel itself diseased, in the midst of sloughing tissues, and the risks of securing the trunk higher up by a separate operation.

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* As in cases cited by Sir W. Savory in "Med. Chirurg. Trans.," Vol. LXIV., p. 21.

Hæmorrhage from malignant growths.

As in sloughing phagedæna, most malignant tumours do not spare the vessels in the tissues among which they spread, and one of the most frequent causes of death in these cases is hæmorrhage from a vessel which is involved in the malignant ulceration. This would be more frequent still, were it not that the vessels are so often previously obliterated. The arrest in these cases, and the precautions to be taken are precisely those which have been mentioned for phagedæna, with the single exception, that it will never be right to attempt to put a ligature on the vessel at the seat of hæmorrhage, that is, in the substance of a malignant growth. But in addition to this form of bleeding by invasion of vessels, malignant tumours are themselves generally very highly vascular, and in the later stages of their growth, break down, and then their ulcerated surfaces are apt to bleed, sometimes very profusely, as may readily be imagined, since the blood supply of some of the softer sarcomata is abundant enough to cause the whole mass to pulsate.

A variety of methods may be adopted for the arrest of this form of bleeding. Moderately firm pressure, cold, as by applications of ice or the ether spray, the use of astringent styptics (and it is in these cases especially that pads soaked in perchloride of iron, or made of styptic cotton or tow, may be usefully employed); all or any of these may in different cases be found efficient. In certain cases, ligature of the main vessel of supply is indicated, as of the lingual artery in some cases of epithelioma of the tongue; but the actual cautery will hardly ever be advisable.

When the ulcerated surface of a malignant growth is apt to bleed, but only occasionally, a good application is a powder of equal parts of crude opium and Cinchona bark, which may be dusted on the part.

Hæmorrhage from a ruptured external aneurism.

Occasionally, but very rarely, an aneurism ruptures externally, and causes violent bleeding, and there are even one or two cases on record in which the occurrence has resulted in the cure of the disease. The surgical proceedings which should be taken for the permanent arrest of this bleeding are not within the scope of this work to discuss, but the measures for stopping it at first, and at once, we must here consider.

Contrary to what one would expect in such cases, the giving way of the tumour occurs insidiously; the aneurism *leaks* rather than bursts (we are speaking of those on the external surface of the body); the skin gets irregularly ulcerated over it, and the first appearance is rather that of a superficial bleeding sore. The bleeding too, is intermittent, and at first, apparently not serious. The loss however at each attack becomes greater and greater, and soon there is a general yielding of the skin, which is now all that restrains the flow, and a gush of blood, which may be immediately fatal, takes place.

Treatment. What should be done in the first instance? We will take as an example an aneurism of the superficial femoral, say, in Hunter's canal. If the condition be that of a slight intermittent oozing from one or two apparently superficial ulcers, in the reddened unhealthy skin lying over the pulsating tumour, the leg should be raised and carefully bandaged from the foot upwards. A Martin's india-rubber bandage is best, and this should be carried somewhat more firmly over the tumour, a folded piece of lint being placed between the skin and the bandage. Some form of tourniquet, *e.g.*, Signorini's (Fig. 11), or Esmarch's india-rubber cord should then be adjusted, so that it can be tightened up in an instant if required. This being done, there is little immediate danger, and time will be given to the visiting surgeon to determine whether he will turn out the contents of the aneurism after opening it freely, and then proceed to ligature both ends of the vessel; whether he will pass a ligature round the femoral, or external iliac arteries; or whether he will adopt any other proceedings for the permanent cure of the disease.

But supposing the case has been allowed to drift on, until there comes a furious gush of blood from a considerable yielding of the skin and sac? There will be no time for deliberate bandaging, but the finger must at once be placed on the main artery (in this case the common femoral) and retained there until replaced by a tourniquet. The bleeding cavity must then be packed most carefully and firmly with compressed sponge or strips of lint, until it is absolutely full, and then pressure made on it from above with a firm ordinary bandage, or an india-rubber one, over a pad.

The lint strips are generally dipped in perchloride of iron solution, but if this can be avoided, it will be better, as the parts are already inclined to slough.

Finally, it may be necessary in some situations, to put the finger into the cavity which is bleeding, to feel for the place whence the rush of blood proceeds, and to arrest it by keeping the finger on the spot till help arrives.

The wound once effectually plugged and compressed, the tourniquet may be gradually slackened, and if the bleeding does not recommence, should be left loose, but in position.

We have been particular in describing the temporary arrest of this form of hæmorrhage, although it is rare, because it serves as an example, that a man should never be allowed to bleed to death from any external hæmorrhage, inasmuch as it may always be arrested, first with the finger placed on the bleeding point, or on the main artery, and then by plugging and pressure.

Secondary hæmorrhage.

SECONDARY HÆMORRHAGE.

A bleeding is called *secondary* when it comes on at some period subsequent to the division or injury of the vessels maimed, either by an accident, or in the course of an operation.

Its divisions.

It is itself divided into *recurrent hæmorrhage*, *true secondary hæmorrhage*, and *intermediary hæmorrhage*.

Recurrent hæmorrhage.

Recurrent, *or reactionary hæmorrhage*, is that form which comes on as soon as the period of lowered cardiac action and partial collapse, which is occasioned by the shock of an operation, or of an accident, passes off, *i.e.*, within four or five hours of the injury. By this time, too, the contraction

Its causes.

occasioned by the exposure and division of the vessels, has largely passed away. There is then present a condition of increased cardiac activity and relaxed vascular walls, so that it is not surprising that very frequently there is free general oozing from a wound, which at the time it was done up appeared quite dry. The bleeding is chiefly capillary, or proceeds from small arterioles, which had been so firmly contracted as not to declare their presence at the former examination. Now, too, larger trunks which have been tied, but not very firmly, may burst their bonds and bleed freely.

Treatment.

If this be slight, as it often is, the serum and blood will remain within the aseptic dressings, and will do no harm. If it show outside, the dressings must be undone and the wound exposed. It may now be syringed out with cold perchloride or carbolic lotion, and a few minutes' delay granted to see its effect. Should the hæmorrhage still go on, the wound must be opened up and the clots cleared out; it will then be seen whether the hæmorrhage proceeds from any vessels requiring torsion or ligature, or whether it is purely capillary. If the former, the vessels must of course be secured; if the latter, the clearing out the clots will have had a very good effect, and this, with a few minutes' exposure to cold, or the application of a hot flannel (see pages 64 and 65) will be sufficient to arrest the bleeding. The wound must then be redressed and put up rather firmly.

It must be recollected that a smart reactionary hæmorrhage and the means taken for its arrest, may be sufficient to cause a collapse, similar to the original one. The bleeding will then cease as it did before, and from the same causes, and it may also be succeeded by a reactionary state, sufficient to cause a further loss of blood.

In these cases, therefore, after reactionary hæmorrhage has once occurred, the patient should be watched.

True secondary hæmorrhage.

True secondary hæmorrhage rarely occurs earlier than a week or ten days after the injury or operation, and its cause is almost always some ulcerative or sloughing condition of the walls of the larger vessels. Thus it may come from an artery which has been ligatured in its continuity, in consequence of the coats near the ligature taking on an unhealthy action; or it may come from a lacerated wound at the time of separation of the sloughs, or from ulceration of a vessel ligatured in the flaps of an amputation wound, etc.

The single exception to this form of hæmorrhage proceeding from a morbid inflammatory process, is in those rare cases in which an animal ligature has become absorbed too quickly, or a silk one has cut the coats or come untied, so that the arterial coats, weakened by the tying, will then give way.

Its arrest.

Secondary hæmorrhage, if it be not more frequent from arteries than from veins, as is sometimes stated, is at least in the former case very much more serious. Here it constitutes a most formidable complication, and in considering the means for its arrest, questions of amputation, re-amputation, ligature of main vessels, etc., have to be weighed by the visiting surgeon, but for us the subject is narrowed to the best ways for its immediate arrest.

When the bleeding comes on, there is often some warning, as by a little dribbling, before there is any great rush of blood, and in that case, elevation and firm compression outside the wound may arrest the flow, until some plan of action has been decided upon. A tourniquet, however, should be in readiness for instant application if required.

From an artery ligatured in continuity.

If the hæmorrhage be from an *artery ligatured in its continuity*, the steps which ought to be taken immediately, and which may suffice in some cases for its permanent arrest, are precisely the same as in the case of an aneurism which has undergone external rupture, and to these the reader is referred. (Page 47.)

From an amputation stump.

If it occurs from the *stump of an amputation*, it must be arrested in the first instance by elevation, and compression of the main artery by the fingers or a tourniquet. The means to be adopted for the permanent arrest will depend on the condition of the stump; whenever it is practicable, the most satisfactory proceeding is to open up the flaps, and tie the artery. This is sometimes not possible from the sloughing condition of the parts, and sometimes not advisable because the flaps are firmly adherent; in these cases the choice will lie between re-amputation, and ligature of the trunk vessel higher up.

From a sloughing wound.

If the hæmorrhage proceed from *extensive sloughing* of a lacerated wound, it takes place about the time of the separation of the sloughs; in dressing bruised wounds therefore, great care should be taken about the tenth day not to tear the sloughs away before the vessels have become occluded by natural processes.

The bleeding is generally arrested by plugging and compression, but any vessel that will hold a ligature should be tied. The actual cautery may be used with good effect, but styptics, especially the perchloride of iron, should be avoided.

Intermediary hæmorrhage from temporary congestion.

There is a third form of bleeding, *intermediary hæmorrhage*, which is neither reactionary, nor exactly true secondary hæmorrhage. It comes on a few days after the infliction of the wound, and appears to proceed from some temporary congestion or undue vascularity of the part, so that the granulations give way. This form is not so important as either of the other kinds, for it does not depend on any serious morbid process. If the bleeding goes on long enough, the congestion will be relieved, so that this form tends to stop "of itself," and in any case, elevation and moderate compression will arrest it.

Bleeders.

Reference has been made several times to the constitutional conditions known as the "*hæmorrhagic diathesis*," and those possessing this diathesis are generally called "bleeders." It is in a very marked degree hereditary, and is transmitted by both the male and the female sides, but it affects males far more frequently.

"Bleeders" manifest their complaint either by spontaneous hæmorrhages from such parts as the gums and palate, the rectum, or the bladder; or by persistent bleeding from some wound, large or small, or by the effusion of blood or blood and serum into the synovial or serous cavities.

General description.

In the case of wounds the importance of the case only gradually develops; there is no furious gush of blood, but a general "weeping" of the whole surface, which looks as if it only required a little time to stop of itself, but at the end of twenty-four hours the position of affairs is precisely the same, with the exception that the loss of blood, continuous as it as been, has caused a distinct constitutional effect, while very probably the pressure employed in futile attempts to check the drain has produced sloughing of the edges of the wound, and hence an enlargement of the bleeding surface. And so matters go on. The blood, natural in its appearance at first, becomes thin and watery, while the patient is exhausted to the last degree, and seems likely to die, it may be from such a trivial injury as an extracted tooth, or a cut finger. Death may indeed occur, but fortunately, and rather curiously, just when the case looks most hopeless, it very frequently begins to improve; the wound takes on a healthy action, the bleeding ceases, and the patient begins to repair the enormous drain on his resources.

In considering the best means of checking this loss of blood, constitutional as well as local remedies must be thought of, so it is important to find out in any case of unusually prolonged bleeding, whether the patient be a genuine "bleeder" or not. Enquiry will generally get out a history, either of some previous injury in which the bleeding "seemed as if it never would stop," or of a father, uncle, or brother who had shown signs of the suspected diathesis.

Local means of arrest.

With regard to the local means of arrest, pressure and plugging should be first resorted to, and in some situations may be applied with sufficient firmness to make a certainty of success; but in many cases it will be found extremely difficult, and sometimes impossible to adjust the compress firmly enough to arrest the bleeding, and yet not so as to cause sloughing of the edges of the wound.

The material for plugging may be soaked in a concentrated solution of perchloride of iron, and we have seen a bad case quite arrested by filling the wound with the German "styptic charpie," readily procurable in London.

Powdered alum, tannin, perchloride of iron, sulphate of copper, and the whole range of those styptics which are not escharotic in their character may be tried as local applications, and have all been found successful in certain cases. But failing pressure, the wisest course will be to apply the actual cautery, very carefully, and at the dullest red heat possible. Owing to the difficulty of keeping Pacquelin's cautery at such a low heat for more than an instant, the old cautery irons are more convenient. The bleeding surface must be quite dry at the instant the iron is applied. The character of the bleeding puts the idea of trying to ligature any of the bleeding vessels out of the question, and a little reflection makes it plain that ligation of the trunk vessel is only substituting two bleeding wounds for one. It is, however, sometimes advisable to strangulate the bleeding part, if it can be isolated, *e.g.*, by passing hare-lip pins deeply below it and twisting silk over them; but there is still some risk of bleeding from the pin-holes.

In a small wound the bleeding may be stopped by means of a pad of wool soaked in collodion, and forcibly held in position until the collodion has set.

If a "bleeder" happens to acquire an ulcer from any cause, the granulations are exceedingly apt to bleed; indeed, a common ulcer on the leg is, to such a person, a very dangerous lesion. As a rule the bleeding is not only on the surface, but takes place in the substance of the granulations, so that the appearance is that of a purple black fungating mass, looking very like true "fungus hæmatodes." In such a case, the best plan is first of all to scrape off the infiltrated granulations down to the underlying fascia; this done, pressure, or the other local means alluded to, can be applied with a much greater prospect of success.

Constitutional treatment.

The constitutional treatment of this form of hæmorrhage is very important; indeed there are few illnesses which fall properly under the surgeon's care, and in which he has to trust so much to the physiological effect of certain drugs on the blood and blood vessels.

Useful drugs.

All those drugs which are in most common use as hæmostatics, and which will be described a little later on, may at times be found useful in this disease; from them, however, one or two may be selected as being the more approved.

Iron perchloride.

Foremost among these is the perchloride of iron, (liq. fer. perchloridi) in large doses, say ʒss. – ʒj, frequently repeated. This often has undoubtedly a very marked effect.

Turpentine.

Turpentine again, in doses of mm. v, x, or xv, at short intervals, has been found very useful.

Ergot and ergotine.

From physiological grounds, the preparations of ergot should be here especially indicated, and ergotine in doses of mm. iii to v, is very useful and trustworthy, but for some reason the liquid extract of ergot has been found to be often almost inert, although freshly prepared. The local effects of subcutaneous injection of ergotine are so marked, that this is probably the best way to administer it.

Opium. The action of opium in quieting and regulating the circulation, gives it a great therapeutic value as an indirect hæmostatic in this form of bleeding, when the heart's action becomes feeble and the pulse empty and jerky.

From our account of the diathesis it must not be supposed that every injury to a "bleeder" is necessarily followed by extreme consequences, nor, on the other hand, that every case of troublesome capillary bleeding, stamps the patient as an example of the condition. There are borderland cases, and also cases which simulate the diathesis, either through simple flabbiness and laxity of the vascular walls, or from the presence of some other constitutional vice, such as leucocythæmia, or scurvy, or the condition commonly known as "scurvy rickets."

CHAPTER IV.

OF SOME PRINCIPAL FORMS OF INTERNAL HÆMORRHAGE, AND THEIR ARREST, AND OF THE TRANSFUSION OF BLOOD.

Internal hæmorrhage.

THE important points to be attended to in promoting the arrest of internal hæmorrhages, may here be briefly considered, those cases only being taken into account in which the loss of blood is sudden, and is the prominent symptom at the moment, whether the cause of the loss be a traumatic or a constitutional one.

Thus apoplexy will be considered under another heading, and for chronic hæmoptysis, renal hæmaturia, etc., the reader is referred to works on the practice of medicine.

General considerations.

Whenever a large quantity of blood escapes from the blood vessels, whether it flows away from the body, or into one of its cavities, the prominent symptoms are those of cerebral anæmia. There is a sudden feeling of nausea and giddiness, with a buzzing in the ears, then the sight goes, and the patient falls to the ground and becomes insensible. In such a case there is sometimes a superficial resemblance to an epileptiform or apoplectic seizure, but as a rule the extreme pallor and the fluttering pulse, which is often nearly extinguished at the wrist, will be sufficient indications of what has happened

Usually, the syncope and the horizontal position involuntarily assumed will in a few minutes effect a reaction (omitting cases immediately fatal), and there is a partial return of consciousness and strength.

Immediate treatment.

The indications for the immediate treatment of severe internal hæmorrhage are sufficiently simple. They may be summarised thus:—

1. Measures to prevent further loss of blood.
2. Measures to keep the circulation quiet.
3. Measures to keep up the blood supply of the nerve centres in the brain for circulation and respiration. And later on
4. Measures to promote rapid formation of new blood.
5. Measures to prevent waste of tissue as far as possible.

To prevent further loss.

(1) The measures for preventing further loss will differ

in different cases, but the chief ones are—absolute rest, local application of cold, and lowering the functional activity of the organs affected, as much as possible. Thus, if the bleeding be from the lungs, the patient should be kept lying flat, with very light clothing, very loose; be made to suck ice, and enjoined not to speak. In this way the lungs are placed at rest, as far as it is possible for them to be.

If the bleeding proceed from an ulcer in the stomach, in addition to lying flat, lumps of ice must be swallowed, cold may be applied to the pit of the stomach, and no food, or anything that may excite the gastric secretion, ought to be taken.

To equalise the circulation.

(2) The absolute rest will greatly tend to equalise the circulation, but it is especially with this view that *venesection* is employed in internal hæmorrhage. This expedient, with the practice of venesection in general, has been out of fashion for many years now, but there are indications that it will soon again be recognised as a convenient and sensible method of lowering the blood pressure.

The art of discriminating between the fit and unfit cases for venesection must be elsewhere learned, but it may be broadly stated that blood-letting is indicated in hæmorrhages associated with high arterial tension, as in some cerebral injuries, or with acute local congestion, as in pneumonia with hæmoptysis; or when, from any cause, the right side of the heart is overloaded, and its action embarrassed.*

To maintain the blood supply to brain.

(3) The fulfilment of the third indication—the blood supply of the respiratory and cardiac nerve centres—is best attained by lying flat. We all know that this is the best position for syncope, because, then, the feeble heart can most readily drive its scant supply of blood to the brain. Placing a patient head downwards, when the breathing has stopped during the administration of chloroform, is only an extension of the same principle.

Extreme syncope.

But in very severe hæmorrhage, position alone may be insufficient, and we may see the syncope getting nearer and nearer to death, from the bloodless condition of the base of the brain. In the first place, all the blood that is in the body should be utilized for the purpose of brain supply. To do this effectually, the head must be lowered and the pelvis raised; the arms held so that the veins tend to empty themselves into the heart, while the legs should be raised, and bandaged from below upwards—an elastic bandage (Martin's) is best—so as to squeeze all the blood out of them, as far as possible. All these proceedings are sometimes called "autotransfusion."

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* How to perform venesection is described later. For a discussion of the indications for its employment and its value, see Dr. Hare's Address, "Good Remedies out of Fashion" (Churchill's, 1883).

Artificial respiration.

In extreme syncope from bleeding, as from any other cause, the surgeon must be prepared for complete failure of the breathing, and must be ready to begin artificial respiration (*q.v.*) whenever he sees the movements of the chest becoming suspiciously shallow. But further, there can be no doubt that, rather than allow a patient to die simply from lack of blood, the deficit ought to be supplied from elsewhere, and so far as our knowledge goes at present, when human blood is not available, that of a lamb or calf may be apparently as beneficial, at any rate in the immediate results; still, the blood of no animal is so efficient as the blood of a healthy man, and no other fluid is as efficient as blood. At the same time those who give their blood should know that sometimes the loss of it in this way has produced ill effects disproportionate to the few ounces which have been taken; and it is certainly better to refrain from bleeding a man or woman who has that sensitive, nervous organisation which so often goes with cultivated intellect, and desire for self-sacrifice, for such an one may be seriously damaged. On the other hand, a man of the type and habits of life of our great grandfathers, who used to be bled every spring and fall of the year, may be even benefited by the loss.

Transfusion.

Whether the fibrin is transfused or not is a matter of no importance; it is the supply of the red corpuscles, as oxygen carriers, that is the object desired.

Whenever transfusion is necessary, time is of the utmost importance, and apparatus may not be at hand; there are therefore recognised two principal methods of transferring the blood, *mediate* and *immediate*. In mediate transfusion the blood is taken as in ordinary venesection (*q.v.*) into a bowl, which is placed in water of about 100° F. The fibrin, as it forms, is removed by a fine wire brush, or what answers very well in a hurry, an egg or "cocktail" whisk. Within the vessel which receives the blood must be placed a strainer of some kind, *e.g.* a muslin bag or a coffee strainer, through which the defibrinated blood must pass before it is used. If a proper syringe with a nozzle which can be inserted into the vein be at hand, all that is necessary is to

Mediate method.

warm it, and fill it carefully, so that no air is injected. In inserting the nozzle, it is better to expose the vein for a quarter of an inch with a scalpel, in order to make sure that the pipe is fairly inside, and is not, as may easily happen, pushed between the sheath and the vessel. If no proper syringe be at hand, a small glass one, with a well-rounded point, may be made to do service.

In the cases of extreme bloodlessness, it is often very difficult to find a suitable vein, and it is therefore all the more necessary to fully expose what is taken to be the vessel. Generally one of the veins at the bend of the elbow is selected ; if that cannot be clearly seen the saphena would probably be the largest and most easy to find, from its fixed position, as it goes through the saphenous opening.

The quantity of blood transfused in different cases varies; as much as twelve ounces have been used, but as a rule from five to six ounces are sufficient sensibly to relieve the syncope.

Immediate method—Aveling's.

The immediate method of transfusion is however by far the readiest and most convenient way of transferring blood from one person to another. It consists essentially in placing the venous systems of the giver and receiver in communication, and then allowing the blood to flow from the former to the latter, and in that direction only. The best known of the apparatus are Roussell's and Aveling's ; the latter only will be described, as it is the simplest and we believe it to be also the most efficient.

As seen in the illustration (Fig. 26.) it consists of india-rubber tubes, with a ball between, like a Higginson's syringe, but without the valves. These tubes are armed, the one with a sharp pointed cannula, the other with one rounded off at the end (sometimes both are sharp). The vein is first found in the giver, and the sharp cannula fairly inserted into it and connected with the ball and tubes, which are themselves filled with warm water. The blood is then allowed to enter by turning on the taps, and as it does so, it expels the water. When the apparatus is full, so that it is certain that there is no air in it, the blunt cannula is pushed into the vein of the receiver, an incision having been made into it with a scalpel.

Two assistants will be required, the first to hold the cannulæ in position, while the second, with the one hand alternately compresses and relaxes the ball, thus drawing blood from the giver, and with the other compresses the tube *behind* the ball when it is full or being squeezed, and *in front* of it while it is expanding. This hand thus does away with any necessity for valves; each squeeze of the ball drives in three drachms of blood, and in this way five or six ounces of blood can be quickly and easily transfused, the main points to be attended to being to avoid the entrance of air, and to inject slowly and very steadily, so as to avoid distressing the feeble circulation. Also to be sure that the vein is entered fairly by the cannula.

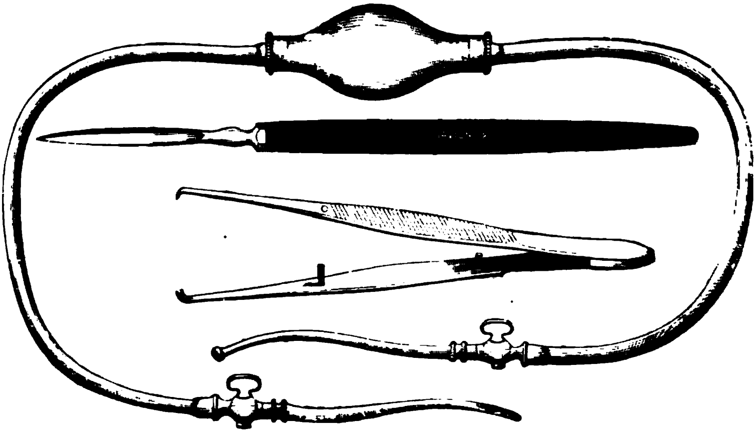

FIG. 26.—*Aveling's Transfusing Apparatus.*

To make fresh blood.

(4) The fourth indication, to promote the formation of fresh blood, is not easy to fulfil. The loss of liquid from the body shows itself in the great thirst always present after serious hæmorrhage. This must be satisfied by iced milk and water; such alcohol as appears to be wanted must be freely diluted. In the case of severe hæmatemesis fluids must be given with more caution, and always be well iced.

To prevent tissue waste.

(5) To prevent, as far as may be, tissue change, or work of any kind of the body is also important. The absolute rest and quietness already advised must therefore be kept up for some days; in many cases moderate doses of opium will be found very useful.

CHAPTER V.

OF STYPTICS, CAUSTICS AS STYPTICS, AND OF THE ACTUAL CAUTERY.

Styptics. Definition.

STYPTICS are substances which, when applied to a bleeding surface, tend to staunch the blood. This they may effect in two or three different ways: thus they may simply form an artificial scab over the surface, or they may condense the tissues and astringe the vessels by combining with and coagulating the albumen present; or this condensing action on the tissues may be powerful enough to destroy their vitality, and so by these "caustics" a destruction comparable with that of the actual cautery may be produced.

The use of styptics was, in former times, far more frequent than it now is; healing by first intention was hardly hoped for, and the surface of a wound received far more well-meant but meddlesome attention than nowadays we are disposed to give it. The occurrence of a superficial slough on its surface was, therefore, looked upon as almost a necessary incident in what was known as the "digestion" of the wound.

Objection to use.

But it is now recognised that any astringent which is either caustic, or strongly astringent, inflicts damage to the tissues to which it is applied, and that it should not be used if the hæmorrhage can be otherwise arrested, or merely for the sake of saving a little time or a little blood.

All styptics do not damage the tissues, but all the more powerful ones do, and to a surgeon's eye there are few more irritating causes of offence than to see a clean cut wound, or some unimportant graze, blackened with perchloride of iron, or nitrate of silver, just because the medical attendant could not wait, or could not properly bandage, or pick up a small artery.

This being understood, the immense value of styptics in proper cases may freely be admitted. The most important may here be enumerated and their application described.

Mechanical.

Cobwebs.
Matico.
Contractile Collodion.
Styptic Tow.
Cotton Wool.

Astringent.

Oil of Turpentine.
Powdered Cinchona Bark.
Creasote.
Hazeline.

Astringent and Caustic in varying degrees.

Carbolic Acid.
Sulphate of Copper.
Sulphate of Iron.
Tannin.
Perchloride of Iron.

Caustic.

Chloride of Zinc.
Nitrate of Silver.
Chromic Acid.
Potassa Fusa.
Nitric Acid.

Before applying any styptic care should be taken that the part is dry. This may be ensured by keeping firm pressure on the wound until the moment of application.

Mechanical styptics. Matico.

The dried leaves of "Piper Angustifolium," or the Matico plant, are imported from Peru, and have a peculiar cobweb-like down on their under surface. Some astringent principle is also contained in the tissue of the leaf.

If the under surface of the whole leaf be applied to a bleeding part, or if the leaves, ground up into a powder, be dusted on it, the fine downy filaments will, with the blood, form a firm adherent scab, and the bleeding will be staunched. This mechanical action is probably the beginning and the end of the "marvellous" action of matico. The infusion or powder taken internally is quite harmless.

Cobwebs.

In precisely a similar fashion does the domestic remedy act, of gathering as many cobwebs as can be quickly collected, and putting them over the surface; and, indeed, although the remedy may seem too homely for the surgeon to use, of its efficacy in staying a brisk capillary oozing, none who have tried it will doubt.

These are not in practical use now, but matico is still in the Pharmacopœia. Their places are now taken by the two following:—

Collodion.

Collodion, prepared by dissolving one ounce of gun cotton in a mixture of thirty-six ounces of ether, and twelve ounces of rectified spirit, is extremely useful in cases of wounds about the face, in which, if a scar has to be avoided, the edges have not only to be brought together, but must be held together firmly enough to prevent blood being effused between them. This is readily done by painting three or four coats of this collodion over the wound with a camel's hair brush, or by saturating a piece of lint in it and applying it to the wound. The collodion, as it dries, contracts, and thus the required pressure is kept up.

Flexible collodion, prepared by adding to six ounces of collodion, two drachms of Canada balsam, and one drachm of castor oil, may be used instead of the above. It is not so liable to crack, but is not so contractile as ordinary collodion.

Astringents (non-caustic). Turpentine. Creasote. Hazeline.

The next three styptic substances on the list after styptic tow and styptic cotton, are all astringent, but not at all caustic, that is they do not produce any sloughing. They are all said to coagulate albumen, on which property *plus* their effect on the blood vessels, their styptic action depends. Their application does not necessarily prevent healing by the first intention. These substances are *oil of turpentine*, *creasote*, and *hazeline.*

Of these the first two may be "dabbed" on the bleeding surface with some lint.* The third may be applied as a lotion, or a pad of lint soaked in it may be placed on the wound.

It is worthy of notice that all three substances are stated to be powerful hæmostatics when taken internally. This is certainly true of the two first, but "hazeline," which is prepared in America from the "witch hazel" (Hamamelis Virginica) is a drug still upon its trial.

Caustic astringents.

We come now to styptics, which, when solid, or in concentrated solutions, are more or less caustic. The most convenient way will be to take them in order of their causticity.

Sulphates of copper and iron

Sulphate of copper and sulphate of iron are both (in the crystalline state) slightly caustic, as well as highly astringent, and they are often found very useful in both capacities. Thus, spongy and bleeding granulations may be rubbed over with the crystals, as may also a leech bite or a bleeding gum. In solutions of various strengths they lose their caustic character, but remain highly astringent, and are used then as local applications in cases of relaxed mucous membranes, fungous granulations, etc.

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* Oil (commonly called spirit) of turpentine should not be dropped on a pad of lint, placed on a wound, *and covered up*, or it will vesicate the part.

Perchloride of iron.

The *perchloride of iron* has quite a specific power as a local application to stop bleeding. The bleeding part may either be touched with the solid salt, or the Liq. Ferri Perchloridi Fort (P.B.) may be brushed over them, or, probably best of all, strips of lint soaked in the same solution may be used to plug the wound or bleeding cavity.

The solid perchloride may also be powdered and dusted on the bleeding surface, while lotions of different strengths, made by diluting the Liquor Ferri Perchloridi, may be used as astringent and hæmostatic applications to the nose, urethra, vagina, uterus, etc. In the concentrated forms this iron salt seems to act by forming a particularly firm spreading clot; it also coagulates the tissues, causes the blood vessels to greatly shrink, and forms clots within them. The parts which are actually in contact with the strong perchloride will die and be cast off in the course of a few days.

Efficient as this styptic is, it is very disagreeable. The intensely astringent taste renders it particularly unpleasant in all injuries about the mouth, and the discolouration and apparent foulness of the wound to which it has been applied, combined with the delay in healing which its use entails, lead most surgeons now to reserve its employment for a last resource; and then its value cannot be over estimated.

Alum. Tannin.

Alum and tannin in powder are astringent, somewhat escharotic, and rather powerfully hæmostatic. They have a similar action when taken internally, the tannic being changed into the gallic acid.* These styptics are commonly applied to bleeding parts in the form of powders, dusted on, but they are still more frequently used as mild escharotics for growths, such as condylomata. The dried alum (A. exsiccata) which has been deprived of its water of crystallisation, is the more powerful.

Carbolic acid.

Probably the best use of *carbolic acid* as a styptic will be found in checking the general capillary oozing of wounds, by washing them over with a solution of a strength of from 1 - 15 to 1 - 25. If a sponge or syringe be used the parts are bathed for a very few seconds. Generally all capillary bleeding ceases, there is no escharotic action, and the antiseptic nature of the solution tends to promote rapid healing.

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* The value of the well known patent medicine "Ruspini's Styptic" appears to depend upon its containing gall nut extract. Mention of existence of this remedy should not be omitted here altogether, if only on account of the high opinion Brodie and Watson entertained of its value as a hæmostatic; and there can be no question as to its efficacy in many cases, although it is not so often used now as heretofore.

In all wounds this "washing through" with a strong carbolic lotion, at the end of the dressing, will be found very efficient in preventing excessive capillary loss of blood.

Caustic styptics.

The following substances when concentrated are all powerful caustics, and to this property owe their power of stopping bleeding. This action alone will be considered here, for they all, in weak solutions, are employed for other purposes. This caustic action is used also for the removal of growths, but this will be afterwards referred to.

The caustics most frequently employed are, in order of severity, nitrate of silver, caustic potash, chromic acid, chloride of zinc, and nitric acid.

Nitrate of silver.

Nitrate of silver or lunar caustic combines with the albumen of the tissues, and when applied in the solid form produces a superficial slough, which is limited in depth, for the silver and albumen compound is hard and dense, and prevents any excess of the caustic that may be present, from causing the cauterisation to be too deep. To this fact its value to a great extent is due.

Lunar caustic is applied in the form of a moulded stick, pointed like a pencil, and held in a metal clip. Its application is almost painless. The point of the stick has but to be held firmly against the bleeding point (*e.g.*, a leech bite, or a dog's bite) for about five seconds, and the bleeding will almost certainly be arrested. It is not suitable for application in this form to a large bleeding surface. This substance is sometimes "mitigated" by the addition of some inert substance, but it is not then used as a styptic, nor are its solutions.

Caustic potash.

Caustic potash is moulded into sticks, and applied like the above. It differs in its action, however, in that this is not limited to the place of application, but, forming a sort of soap with the tissues, spreads to an extent rather difficult to estimate beforehand. It is a very fairly efficient styptic, and like the silver salt may be "mitigated" and rendered less deliquescent by admixture with lime.

Caustic soda.

Caustic soda may be used in all cases as a styptic instead of the potash salt, to which, in all respects, it is similar, save that it is slightly weaker and slightly less deliquescent.

Chromic acid.

Chromic acid is a powerful caustic, but its deliquescence renders it difficult to use. It is most conveniently applied by fusing a crystal of the acid upon the end of a silver probe. It is chiefly employed for the removal of small polypi, and will be again mentioned under that head.

Chloride of zinc.

Chloride of zinc is a very powerful escharotic, but its action does not spread indefinitely through the tissues. It may be applied either as a moulded stick, or as a paste mixed with flour. It is more used to remove cancerous growths, etc., than as a styptic. (Further notice of its general use in solution in the dressing of wounds will be given under that head.)

Nitric acid.

Nitric acid combines with the albumen of the tissues to form picric acid, and thus its action is limited, for the latter has not any caustic action. It is an extremely powerful, and, in proper cases, a most useful styptic; thus it may be used in bleeding from fungous or malignant granulations. Its employment as a styptic, however, is not common.

Cold.

The application of cold to a bleeding part has always been recognised as one of the most valuable means of arrest.

Usefulness of exposure.

Free exposure to the air is often alone sufficient to promote coagulation of the blood, and constriction of the blood vessels. This may be seen in cases of recurrent hæmorrhage after an amputation or any other large cutting operation, when a few hours after the operation the wound or the flaps become distended with blood, which may be dripping away at quite an alarming rate. In such a case if the flaps be opened and the clots cleared out, so that the air can get to the surface of the wound and to the ends of the vessels, the bleeding will very probably cease without anything further being done, provided of course, that no big vessel has been overlooked.

Cold water or ice.

Should exposure to air not be enough, cold water or ice (the latter especially), may be very powerful styptics. A lump of ice applied to a bleeding surface may cause an artery, nearly as large as the radial at the wrist, to contract and cease to bleed.

The ether spray.

Another very efficient way of applying cold is by means of the ether spray. The effect of this spray should not be pushed so far as to cause the parts to be absolutely congealed, if this can be helped, for they become very painful on thawing, and the blood vessels being partly paralysed the bleeding is apt to recur.

By means of this spray we have seen furious bleeding from a fungating cancer of the breast completely arrested in less than fifteen seconds.

Arrest by means of hot water.

As a converse to this method of freezing, another way of stopping general oozing is too rarely employed in this country, namely, by the application of a flannel wrung out of water as hot as can be borne by the skin, *i.e.*, about 120° F., but not so thoroughly as to be quite dry, and applied immediately. This should be pressed on the bleeding surface (*e.g.*, to an amputation flap) for a few seconds. On its removal, the tissues will have a whitish look and the hæmorrhage will have all but ceased. The mode of action would seem to be a direct stimulation of the vaso-constrictor nerves, or perhaps of the musculature of the arterioles, as a temperature of 100° to 105° is known to produce a tonic contraction of muscular tissue.

The effect of hot water injections on uterine hæmorrhages is very well understood by obstetricians.

Actual cautery.

We come now to "that cruel and barbarous method" of stopping bleeding which Ambrose Paré denounced, and which was a few years ago only employed rarely, and in cases where the bleeding vessel could not be secured in any other way.

Now, however, owing to the improvements in the instruments, and to the fact that anæsthesia has robbed the actual cautery of half its terrors, it is very frequently employed to arrest hæmorrhage, or for counter irritation, or for the removal of tumours, and by some surgeons even in operations, such as for strangulated hernia, which are generally considered as essentially requiring the use of the knife.

The principal forms of apparatus for the application of the actual cautery are the old cautery irons, the galvano-cautery, and Pacquelin's thermo-cautery. Other forms there are, such as the gas cautery of Dr. Bruce, but they are not now in general use.

Cautery irons.

Cautery irons (Fig. 27) are still frequently employed to stop bleeding, or for the purposes of cautery. They, however, are gradually being displaced by the newer forms mentioned above.

These irons are of precisely the same shape and size as they were in the days of Scultetus, or still further back. They consist of pieces of iron with ends of various shapes, themselves of iron or copper, set into ordinary handles; they, indeed, are just like a whitesmith's soldering iron, ending either in a point or a "button," a straight or bent "olive," etc., and the best way to heat them is to put them into the fire

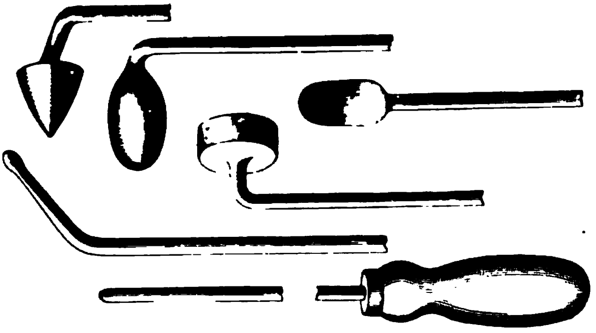

FIG. 27.—*Examples of Cautery Irons.*

Proper heat.

The most efficient heat for the arrest of bleeding is just a visible red, not glowing, but still plainly red hot. If this heat be exceeded, the iron begins to cut rather than sear the tissues. The iron should be wiped clean from the fire, and the bleeding part itself should be dried as far as possible.

Mode of application.

The iron should be passed over the surface very lightly, or the bleeding point should be quickly touched, for contact of the tissues with the iron for more than a moment leads to the parts sticking to the metal, sometimes so much so that they are pulled away with it, and there is still a worse hæmorrhage.

To bone should be avoided.

The cautery used often to be applied to the bleeding surface of a bone, but this should be avoided lest necrosis follow. Cauterisation seems to cause necrosis more certainly than any other injury to bone, so that it should not be used for counter irritation on the scalp, or the prominences of the jaws, or wherever the bone is close to the skin.

In old days the bone in amputations was regularly seared with the iron, and as regularly necrosed away, so that we find in the directions for the after treatment of these cases, that the wound had to be kept open for months after the operation, to allow of the escape of the sequestrum.

Galvano-cautery.

Galvano-cautery. This apparatus is a great advance upon the cautery irons, and is itself well enough adapted for arresting bleeding. It cannot, however, be got ready quickly, and hence is more used for surgical purposes as écraseur, or for burning away warty growths, etc., than as a styptic apparatus; but it will be convenient to describe it here.

The principle on which it depends is that platinum, a metal of high resistance and great infusibility, will get red or white hot, if a galvanic current of sufficient intensity be passed through it.

Not commonly used as a styptic.

The wires from a battery, such as Smee's or Daniell's, of from 4 to 6 cells, are connected by binding screws to the galvano-cautery. By pressing on a knob the electric circle is completed by making contact between the positive and negative wires respectively from the battery, and the two terminals of the rheophore or cauterizing part, which fit into the handle as shown in the figure. In this way the current passes through the rheophore, whether it be a noose of wire or of some other shape, when the knob is pressed, and then only.

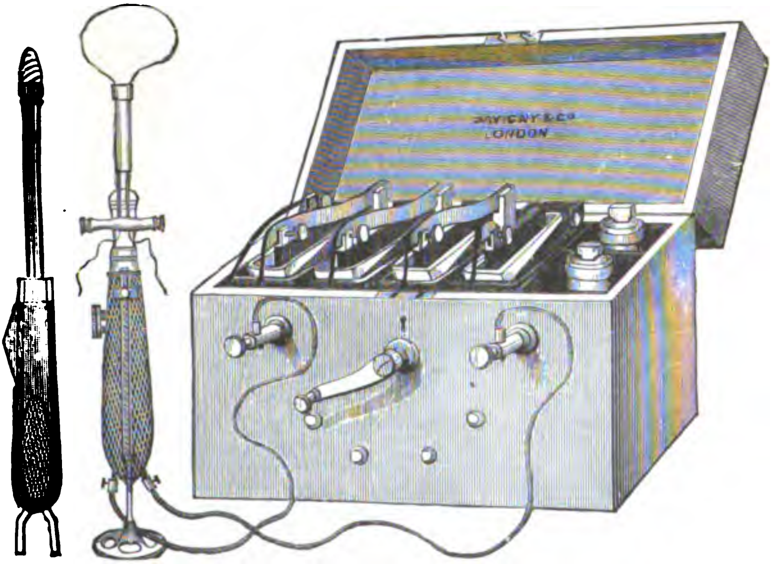

Fig. 28.—*Form of Galvano-Cautery.*

The resistance to this current in the platinum is so great that heat is generated sufficient to cause the wire to become of a dazzling whiteness.

If the rheophore used be of the kind known as the galvanic écraseur, the wire which has to be heated, is so arranged that it can be shortened up like a snare as shown in the figure.

Galvanic écraseur.

Two great advantages are possessed by this galvano-cautery. The first is that a very small pointed rheophore may be used to a limited bleeding surface without its losing heat before it can be well applied. The second is that the wire as a noose can be fitted round whatever requires cauterisation with the fingers, before the knob is pressed, and the wire becomes hot.

This, as may be imagined, is very often an enormous gain. The difficulty of its use is the keeping the temperature of the wire low enough, when once contact has been made.

Pacquelin's thermo-cautery. The latest development in the way of a cautery is Pacquelin's (Fig. 29.)

It depends on the principle that when the vapour of benzoline or some other high olefine is driven over heated platinum, its rapid incandescence is sufficient to maintain this heat very perfectly indeed. In the figure it will be seen that with an ordinary Higginson's syringe and safety ball to give a continuous blast, atmospheric air is blown over the surface of the benzoline, and then being saturated with its vapour, passes on through the tube and through the holder, and thence into the air through the platinum point, which contains some spongy platinum.

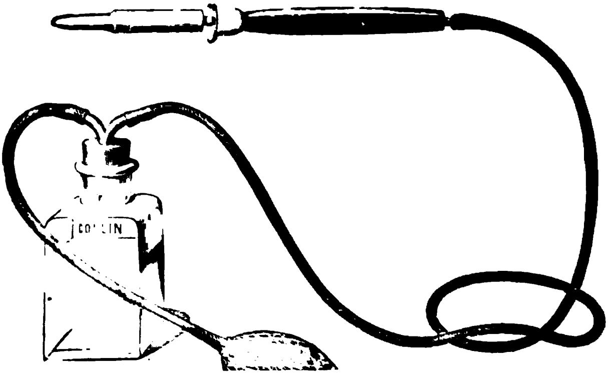

Fig. 29.—*Pacquelin's Thermo-Cautery.*

The platinum point having been first heated in a spirit flame until it just begins to glow, the ball of the syringe is worked by hand, and the air charged with benzoline undergoes active combustion as it passes through the point, and thus not only maintains its heat, but increases it to whiteness.

The readiest way to heat the platinum is to use the spirit lamp as a blow-pipe flame, for which it is generally arranged, and, as before, the heat to employ as a styptic is a dull almost invisible red.

The points are of various shapes, some of which are shown in Figs. 30 to 32, and in Fig. 33 is seen the principle applied to a pair of scissors, one blade of which is of steel

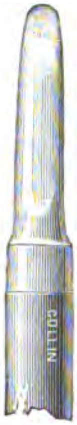

Fig. 30.

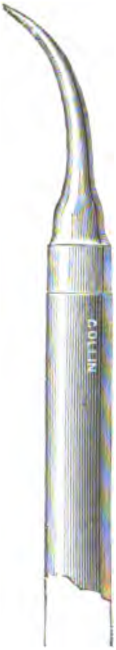

Fig. 31.

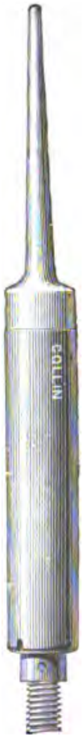

Fig. 32.

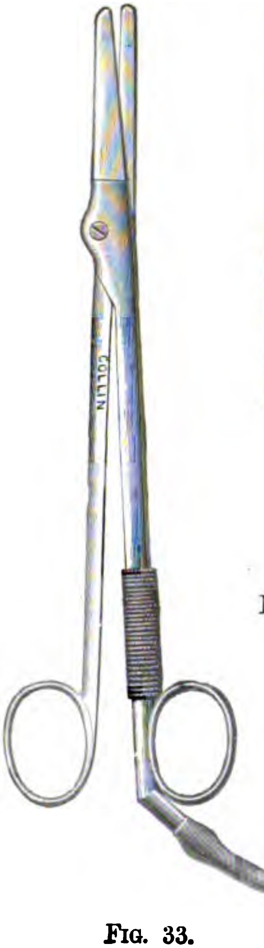

Fig. 33.

nickel-plated, and the other, through which the vapour passes, is of platinum.

Applications.

These various shapes, and the fact that they are called "knives" of different kinds, point to the employment of this form of cautery for the division of tissues. By its means amputations have been performed, and hernias relieved from strangulation, and though these extreme applications may not be found practically useful, still for the removal of tumours, etc., it is impossible to overrate the importance of this nearly bloodless method of operation.

The cautery should be in charge of an assistant who has nothing else to do to distract his attention, and care must be taken that the benzoline is quite pure.

CHAPTER VI.

OF SOME OF THE PRINCIPAL DRUGS USED INTERNALLY FOR THE ARREST OF BLEEDING.

Some of the principal drugs used in hæmorrhage.

A LIST of all the drugs which have been administered with the intention of directly or indirectly arresting hæmorrhage, would be found to comprise a very large section of the Pharmacopœia. Such a list, moreover, unaccompanied by full descriptions of all the cases in which the drugs might individually be indicated, would only be useless.

But the drugs now to be mentioned have all proved themselves hæmostatics of more or less power, and a knowledge of their comparative activity is very necessary to the practitioner.

It is, naturally, in cases of internal hæmorrhage that hæmostatic drugs are most often used. It seems unnecessary to employ constitutional remedies when the loss of blood can be mechanically restrained, and so it happens (though it may well be doubted whether in this practice we are wise) that those remedies which affect the vessels, the vaso-motor nerves, the blood, or the cardiac activity, and which may effectually restrain a loss of blood from any part, are brought into service only when the bleeding comes from parts out of reach of surgical interference. The principal types of these internal hæmorrhages will be described directly.

Iron.

Heading the list of the internal remedies for bleeding come the astringent preparations of *iron*, and more especially of its perchloride salt. The employment of this drug has been so often mentioned that it is unnecessary to do more than to remind the student that, as a hæmostatic, the doses must be full, say 30 or 40 drops of the *liq. ferri perchlor.*, or 6 to 10 of the *liq. ferri perchlor. fortior.*

Acetate of lead.

The *acetate of lead*, especially when combined with opium, is of frequent use in hæmoptysis and similar bleedings. A common preparation is the *pil. plumbi subacetatis c. opio*, in iii.–v. grs. doses. The proportion of the lead salt in the pill is large (¾ of the whole), therefore, although at first it may be necessary to repeat the dose at short intervals, it must not be persevered with for more than two or three days. It is also extremely useful in typhoidal hæmorrhages from the bowels.

Opium or morphia.

Opium or Morphia has also been used alone in hæmoptysis, given in small and frequent doses, and with very good results. For example, the hypodermic injection of one-sixth of a grain of morphia, followed by injections of one-eighth of a grain at intervals of three hours is often very successful.

Turpentine.

Turpentine has been already mentioned as a hæmostatic, and it is undoubtedly a very valuable one. It is very frequently used in hæmaturia, from whatever cause it may arise. In cases not dependent on or complicated by Bright's disease, as much as a drachm, every three or four hours, may be given, but if this disease be present, smaller doses must be employed, as v. to x. drops. These smaller doses, frequently repeated, appear in most cases to be as useful as the larger, and do not excite purging.

Turpentine is also used to check bleeding from the lungs, intestines, nose, uterus, etc.*

Ergot and ergotine.

Ergot and Ergotine. The active principle of ergot of rye has a very powerful effect on all organic muscular fibre, and especially on the walls of the blood vessels, and of the uterus. There is little doubt that the dry gangrene, caused by eating bread made from "spurred rye," is due to the prolonged spasm of the arterioles of the extremities. As might be expected, therefore, preparations of ergot are powerful hæmostatics; the principal ones used are the liquid extract of ergot and ergotine. The former is given by the mouth, in doses of 20 to 40 drops, or a drachm, the latter in three to five minim doses, generally hypodermically. The liquid extract is most commonly used, but it is not trustworthy, even when freshly prepared. Bonjean's ergotin (an alcoholic extract of a watery extract of ergot) is the preparation generally used for injection, which should be made in such a place as the gluteal region, deeply in the muscular tissue.

For the special action of ergot on the uterus, and the indications for its employment in hæmorrhage therefrom, and as a stimulant to its muscular contraction, the student is referred to works on midwifery; in hæmoptysis, epistaxis, hæmatemesis, typhoidal hæmorrhage, the hæmorrhagic diathesis *(v. sup.)*, and in purpura, it may be successfully administered. According to Ringer there is sometimes a good deal of local irritation caused by its injection. This probably depends on the mode of preparation.

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* For a fuller account of its action, see Dr. Ringer's "Handbook of Therapeutics."

Digitalis. *Digitalis*, whose constitutional action on the arterioles in many ways resembles that of ergot, may also be used as a hæmostatic, especially in hæmoptysis, menorrhagia, and in some forms of recurrent nose-bleeding. It must be given in bleeding with the same precautions as when employed in other cases. The *tincture* and the *infusion* are the most useful preparations, and there appear to be certain advantages in using a mixture of these, *e.g.*, half a drachm of the tincture with half an ounce of the infusion for a dose.

Acids—Sulphuric. Most of the acids used as therapeutic agents, but especially *sulphuric* acid, are useful in checking bleeding from various internal organs; thus the *dilute sulphuric acid*, or the *aromatic sulphuric acid*, in doses of 10 to 30 minims, is found useful in hæmoptysis, but it is rarely if ever given in acute cases of internal hæmorrhage.

In addition to these principal drugs, the following should be mentioned as having a reputation as hæmostatics, but which do not require a detailed description, namely, preparations of *alum*, *gallic* and *tannic* acids, *ipecacuanha*, *creasote*, and *hamamelis*. This last, prepared from the Witch Hazel, is credited with truly marvellous powers, restraining bleedings of all kinds, internal and external. It can hardly yet, however, be considered to have an established place in this country, but it is quite probable that it may be useful in bleeding piles, and dysentery, or in hæmaturia, in doses of about 20 drops of the tincture to a drachm of water; the value of gallic acid, however, rests on a Gallic. much surer foundation, especially in cases of hæmaturia; it has already been mentioned that Ruspini's styptic probably owes its virtues chiefly to the presence of this acid.

SECTION II.

OF APPARATUS FOR RESTRAINT AND SUPPORT (BANDAGES, SPLINTS, ETC.).

CHAPTER VII.

OF BANDAGES AND KNOTS.

THE first part of this section deals with the several kinds of bandages, and the second part with splints in their varieties and modes of application.

Of bandages. General considerations.

On all sides the tendency of modern surgery is towards greater simplicity in dressing wounds, and in other procedures which involve the use of bandages. The number of distinct "patterns" of bandages now in use is very much less than we find described even in recent books on the subject, and infinitely less than classical authors, such as Scultetus or Paré considered it necessary to describe and figure. Only those ways of applying bandages which are now in constant use will here be described.

Bandages may be roughly divided into "triangulars," or "scarfs," "rollers," and bandages of special form, such as the "T," the "H," or the "many tailed." The material of which they are made is usually grey shirting, *i.e.*, unbleached calico, but roller bandages are often made of flannel, or of some woven material, for greater elasticity or strength; or of muslin for holding plaster of Paris, etc. These, with some other special forms of bandage will be described later.

Choice of kind of bandage.

The choice of the form of bandage, and of the material, will depend on consideration of such points as these:—

The amount of restraint or support required. Thus, a simple triangular bandage will serve best to keep a water dressing on the scalp, while a twisted or knotted roller will be required to restrain the hæmorrhage from a recent wound there.

The effect of the bandage on the skin and circulation of the part. Consideration of this point leads to the selection of material, care as to its tightness, and choice of the best method of applying it. Thus in a limb likely to swell, an elastic pattern, such as a "figure of 8," will be chosen, while if firmness be most required, the "turned" bandage should be used.

The length of time the bandage will have to be kept on. If the bandage be for a temporary purpose only, there will not be the same elaboration required as if it were meant to be kept on for some time; in this latter case the particular plan will often be settled from considerations of future cleanliness.

The triangular bandage.

The triangular or scarf bandage is the half of a square 36 inches, and is usually made of unbleached calico. This bandage has for some years been used in military surgery, but in the surgical work of civil hospitals it is still much neglected, although its use now is beginning to be more recognised. It is peculiarly applicable to out-patient surgery, or to the dressing of accidental injuries, and can be used for dressings of very different kinds, indeed, in almost all forms except when a smooth, even, and regular pressure is required.*

As a cravat.

The first and most obvious use of this bandage is to simply tie it round where it may be wanted with a reef knot, it having been previously folded up into a cravat. In a case of venesection the arrest of the venous circulation above the incision may be effected thus, or improvised splints may be attached, or a leg swung from a cradle, etc.

The sling.

The *sling* is another very useful bandage, and very quickly put on; indeed, of all the applications of the

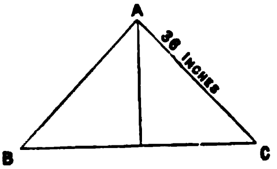

FIG. 34.—*The Triangular Bandage.*

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* The very numerous uses to which this bandage may be put were first worked out by a Swiss surgeon, Dr. Mayor. Professor Esmarch has also strongly advocated its usefulness in civil and military ambulance work.

triangle it is the most frequently required. Although its application may be shown in a few seconds, a written description of it, as with other bandages and knots, is more complicated.

Let the right angled corner be called A, and the upper and lower acute angled ones B and C respectively.* Standing in front of the patient, corner A should be placed in the axillary line on the affected side, midway between the axilla and the ilium, B should reach up to, and hang over the opposite shoulder. The line B to C will then hang diagonally across the body, and between it and the arm to be slung. The arm should be placed in the required position, and C brought up over the shoulder on the affected side and tied with B in a bow behind the neck. The elbow should then be kept in position by pinning A round it as shown in the figure. (Fig. 35.)

The short sling. In slinging the fore-arm the sling should be made just short enough to slightly elevate the shoulder, or the patient will not trust all the weight of the limb to it. The hand should be a little higher than the elbow. Sometimes, as in fractures of the humerus, the weight of the forearm is used

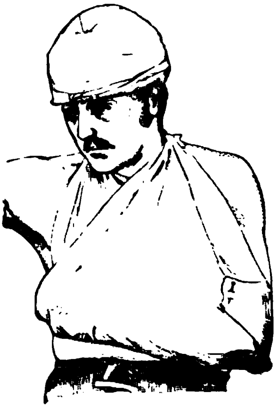

FIG. 35.—*The Sling and Head Bandages.*

as an extension, while the hand and wrist alone are slung by the bandage folded up into a cravat, three or four inches wide, and tied behind the neck. In this case the positions of the ends of the sling should be reversed, the anterior going over the shoulder of the unaffected side.

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* These letters apply to the rest of the triangular bandages where they appear on the figures in the same way.

The head bandage.

The head bandage (Fig. 35) differs hardly at all from the picturesque head-dress of the Italians, which may be seen worn in the metropolis by the women organ-grinders of Saffron Hill. It is very useful as a cap to retain dressings in their place on the scalp, but it is not fitted for compression. As a cap it is infinitely superior to the "capeline" roller bandage, which is hot, and difficult to apply.

Standing behind the patient, who should be sitting down, the middle of the long side of the bandage, opposite A, is placed along the forehead above the eyes, the triangle covering the head, and corner A hanging down behind; the rest of the long side is then brought round the sides of the head, taking care that the hands, as they apply the bandage, are kept low, so as to bring the lower edge well below the occiput. The tails B and C should be crossed, *not knotted*, over A, below the occipital protuberance, and brought forward again round the head to the forehead, where they must be tied. A is then turned up and pinned to the surface of the triangle on the head.

The only points to be attended to, are the keeping the hands low while working from before backwards, and to cross the ends well below the occiput. If this is done the cap cannot slip off, and if not, no tightness will make it firm.

Chest or back bandage

The chest or back bandage (Fig. 36 and 37) is again very

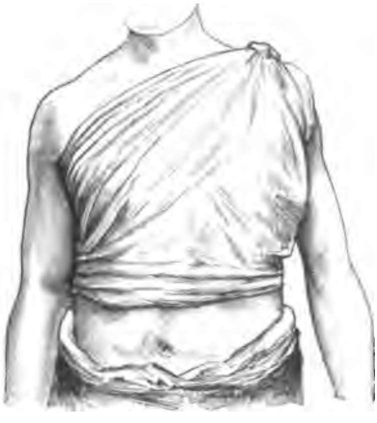


FIG. 36.—*The Chest Bandage.*

useful for retaining such applications as poultices to the trunk, and its employment saves much laborious and wasteful use of broad roller bandages, which do not answer the purpose nearly as well.

The method is the same whether the bandage be applied in front or behind, so that one description will suffice for both back and front, if the terms are reversed.

Standing in front of the patient the right angled corner A is placed over one shoulder, and the long side adjusted round the waist. Then the ends B and C are tied behind, on the same side as the shoulder over which A is hanging.

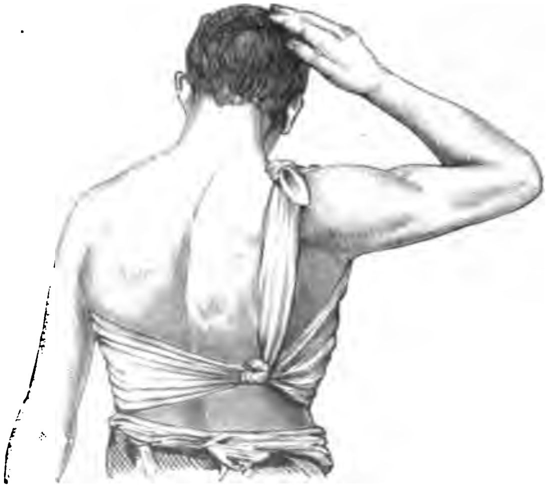


FIG. 37.—*The Back Bandage.*

Thus one of the ends will be left long at the waist behind, and this should be taken up and fastened to A, with a knot or a safety-pin, the junction being about the posterior border of the scapula, and therefore out of the way of pressure when the patient lies down.

The shoulder bandage.

The shoulder is most securely bandaged with two triangles as in Fig. 38. One, folded into a scarf, is fastened diagonally across the body, over the injured shoulder, and under the opposite arm-pit. The corner A of the other is then pinned to it so that the centre of this bandage covers the point of the shoulder, and B and C are crossed over and tied round the arm below the axilla.

The shoulder may also have a dressing retained upon it by using one triangle only, on the same plan as for the knee (Fig. 39), namely, by placing the bandage so that the point of the shoulder is covered by its centre, with A pointing towards the ear, and the long side lying horizontally across the arm. B and C are brought round and crossed behind the arm below the arm-pit, and then brought up and tied above the shoulder over A, which may be turned down and pinned. In these bandages there is no pressure upon, or restraint of the joint itself; this can only be attained by the roller.

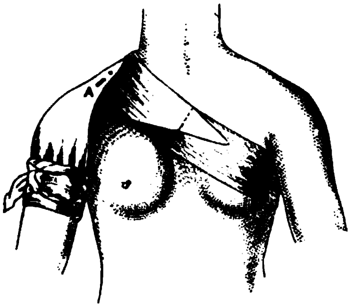


FIG. 38.—*The Shoulder Bandage, with two Triangles.*

The same remark applies to the application of the triangular

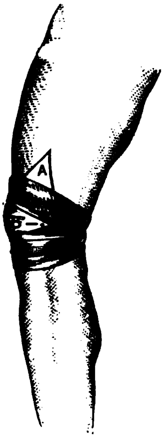


FIG. 39.—*Bandage for the Knee, etc.*

For the knee or elbow.

bandage to the *elbow, knee, hand, and foot.* The methods of application in all these cases are similar. In the elbow and knee A is put upwards, the joint is covered by the middle of the bandage, and the long side lies horizontally across the forearm or the leg. B and C are then crossed behind the limb, brought round and tied in front, and A is then turned down over the knot and pinned.

For hand or foot.

For the hand or foot the limb is placed with the digits pointing to A, and with the end of the big toe or the middle finger at the centre of the bandage. A is turned over the hand or the foot; B and C are then brought up and crossed over the back of the wrist or the ankle, and tied in a bow or reef knot behind.

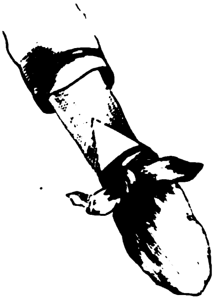


Fig. 40.—*The Hand, bandaged.*

For a stump.

In the same way *a stump* (Fig. 41) may be easily and well tied up, provided that pressure be not required.

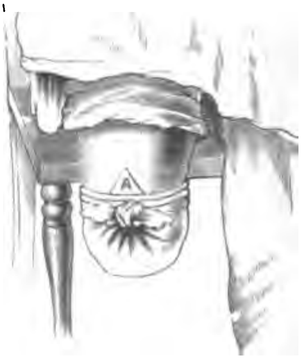


Fig. 41.—*A Stump, bandaged.*

For the gluteal region.

Bandages of the gluteal region. The most useful are the *gluteal*, the *perineal*, and the *scrotal*. In all of these, two triangles will be required, the one for the part itself being attached to the other, which is fastened as a belt round the waist. In the *gluteal* bandage (Fig. 42), the belt being tied round, A is fastened to it behind, above the posterior iliac spine, so that the middle of the base of the triangle falls just below the *gluteal* fold. B and C are then brought round the top of the thigh and knotted or pinned together. Both buttocks of course may be bandaged if three triangles are used.

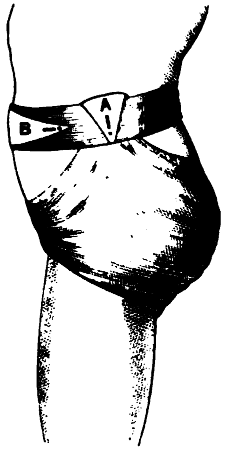


FIG. 42.—*Gluteal Bandage.*

For the perinæum.

The bandage for the *perinæum* is usually applied by folding both bandages into cravats, and fastening one as a belt, and the other in the middle line behind and in front, passing it between the legs and spreading it out a little in the perinæum.

A more efficient bandage, which serves at the same time to cover the buttocks, can be made by reducing the bandage from a right angled to an acute angled triangle, by taking in a plait of about six inches in the base, or long side of the triangle, then fastening A in front of the pubes, and the middle of the base (for the width of the plait) behind, to the belt with safety pins.

There will then be three folds of the bandage smoothly covering the perinæum, while B and C being brought round to the sides, will cover the buttocks, and may be fastened to the belt towards the middle line in front.

For the scrotum.

The *scrotal* bandage generally requires a smaller second triangle than the others, or a large one folded once will do. It is adjusted thus:—The belt being put on as before, A is fastened to it in the middle line in front, so that the middle of the base comes to the central point of the perinæum. The scrotum and penis are then slung up and covered by bringing up B and C, turning them round the belt on either side of the middle line, from behind forwards, and passing underneath first. They are then tied together in a bow or knot over the root of the penis, as is usually figured, or secured with pins to the belt, as in Fig. 43.

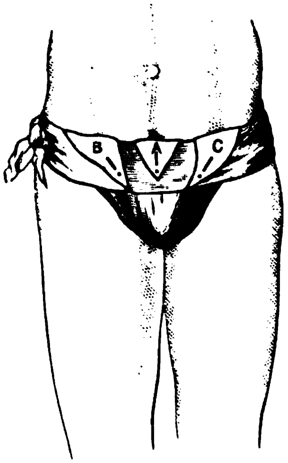


FIG. 43.—*Scrotal Bandage.*

For the groin.

Lastly, a tolerably efficient bandage *for one or both groins* may be fashioned by folding a triangle as a scarf and then applying it as a simple figure of 8 (often wrongly called a spica), placing the middle of the scarf at the apex of the fork of the legs, carrying the extremities along the fold of the groin in front, and of the buttock behind, crossing them at the great trochanter, and then carrying them round the pelvis to the opposite side, keeping below its brim, and tying the ends together (Fig. 44).

The roller bandage.

To bandage neatly is to bandage well, and to be able to bandage well is essential to the practical surgeon. The art of using the roller bandage properly is one not to be learned without practice, even though it be freely allowed that the subject has been quite uselessly complicated by needless rules and patterns.

Materials. As to the materials for these roller bandages, it has been said before that a strip of any stuff which fulfils the conditions of sufficient strength, with lightness and softness, will do. The length of the strip varies from 4½ to 6 yards, the width from 2 to 4 inches; 2½ and 3½ inches being the commonest sizes.

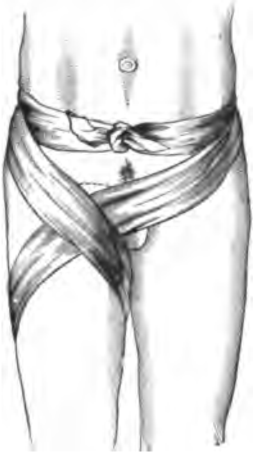


FIG. 44.—*Bandage for Groin.*

For the purposes of description roller bandages may be divided into *elastic*, *semi-elastic*, and *in-elastic* kinds.

Elastic. Elastic bandages, of which there are several kinds, woven, india-rubber, etc., will be described under the heading "Special Bandages."

Semi-elastic. The semi-elastic bandages are either woven in a special manner or made of a somewhat elastic material. Under this heading come all flannel bandages, domette, cotton or silk net, etc.

The application. The application of these bandages is much more simple than that of the in-elastic, for they will lie smoothly if they are merely rolled on firmly, so that they hardly ever require turning or other manipulation. They should be rolled up rather loosely before use.

The in-elastic.

The in-elastic, or common bandages, are the most frequently used, especially in hospital, where the other kinds would be too expensive, even if they were firm enough for the requirements.

They are usually made of "grey shirting" or unbleached calico, or the same bleached; or for bandages about the eyes or face, a very cool light bandage may be made of finer cotton stuff or linen. Very old worn damask linen is not infrequently used for covering pads or cushions, and speaking generally, it may be said that washed stuffs are better than new, which are apt to contain a stiffening dressing. They should always be torn, and no self-edges retained.

The general rule is to use the 2½ inch bandage for the arms and head, the 3½ inch for the legs and pelvis, and the 4½ inch width for the chest and abdomen.

Except for the trunk, however, it will be found that the narrowest bandage is the easiest and the most comfortable to apply in all cases.

Application of roller—reversing.

In order to apply the *common roller bandage* to any part of the body, the first thing to learn is how to judge of the firmness and support required, and to distribute the pressure evenly about the limb. For this purpose the bandage must always be kept rolled up (dropping it is a sure sign of a bungler or beginner), and held (as in Fig. 46) three or four inches away from the part, while the finger and thumb are used to retain the bandage in its place when it is being applied. The next point is the manipulation known as "turning" or "reversing," by means of which the bandage is turned over on itself while it is being applied. The object of this turning is that the bandage

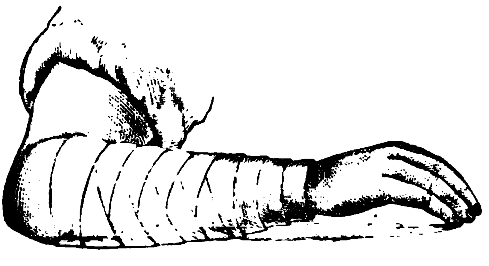


FIG. 45.—*Forearm bandaged below with a simple Spiral; above with the "Reversed" Spiral Roller. The latter grasps the limb evenly, the former does not.*

may lie smoothly, and be firm as well, for inasmuch as all parts of the limbs, etc., are constantly varying in diameter, and the edges of the bandage will not stretch to make one side longer than the other, it follows that if it be simply rolled on in a spiral fashion, only the largest diameter of the limb covered by each turn of the bandage will be grasped by it, and the bandage will be loose elsewhere, as in Fig. 45.

To avoid this, the bandage is, when necessary, turned over as in Fig. 46, and by this means the upper and lower edges are frequently changed, so that the whole width of the bandage grips the limb. This turning requires a little knack, but is easily learned. The secret of doing it well consists in having the portion in the hand (Fig. 46) quite loose, so that by bringing the roller down, it naturally falls over. The thumb must, therefore, be holding the turn of the bandage last applied during this manœuvre. Moreover, the bandage should be brought across the limb with a good slope upwards, say 45° to the long axis, and the reverse similarly be brought boldly down, so that the bandage is well doubled over, otherwise some of the fold will appear on the other side of the limb when the bandage comes round.

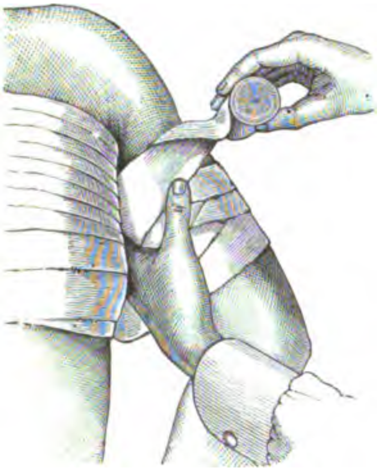


FIG. 46.—*Application of the Reversed Spiral.*

The most common fault is that of screwing the roller round on its own axis, instead of allowing the bandage to fall over into position, as it should do almost of its own accord.

As a rule it is best to turn every time the bandage comes round, and the turns should be made in the same straight line; but these points are not essential, and indeed both depend rather on the æsthetics of bandaging, than on any practical advantage.

Another rule, which may often be more honoured in the breach than in the observance, is that the bandage must be rolled on from within outwards. Thus in fractures of the thigh (See Fig. 120), if the leg be adjusted to the splint, and the bandage put on in accordance with this rule, every turn that is made will tend slightly to increase that external rotation which is the great obstacle to proper position, while the reverse will be the case if the bandage be applied from without inwards.

The roller bandage with reverses is the commonest of all the ways of bandaging. It may be applied to the trunk or limbs (as in Figs. 46 and 47), to fasten splints, and on an infinite number of other occasions.

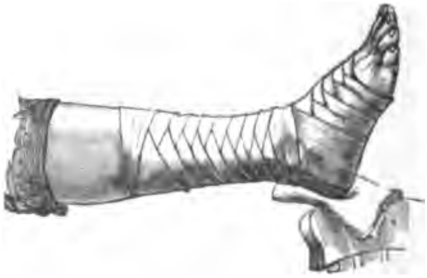


FIG. 47.—*Reversed Spiral of Foot and Leg.*

Nevertheless it is somewhat liable to slip, is not elastic, and is not suited for the neighbourhood of joints.

The double-headed spiral with reverses.

In its stead, a pattern of roller bandage which is hardly ever used in England, might well be employed more frequently, namely, the *double headed spiral with reverses.* (Fig. 48). Its description, like that of many other bandages, is more complex than its application. The bandage is a combination of a simple spiral roller, with a reversed spiral, so that whilst one head of the roller is applied spirally, each of the turns thus made is covered and fixed by a reversed turn made with the other head. Inasmuch as even compression can always (other things being equal) be more efficiently made with a double headed, than with a single roller, the value of this pattern lies in the firmness with which it can be applied to a limb, while it is nearly impossible that it should slip. The heads must of course be of unequal length; that used for the reverses being the longer. The pattern requires some practice to apply with ease, but the labour will be well spent.

Figure of 8

A pattern which is at once firm and elastic, and which can be applied over most articulations, is the *figure of 8* (Fig. 49). This bandage, when applied to the length of the limb, or over a joint so as to cover it completely, presents much the same appearance when finished as the spiral roller with reverses (compare Figs. 46 and 49), but in its application it is entirely different. The illustration on page 88 (Fig. 49) will give a better idea of its application than any words can do. The great point to bear in mind is to make the loops of the 8 as open as possible, by going boldly up the limb and coming down again as far as the bandage will allow.

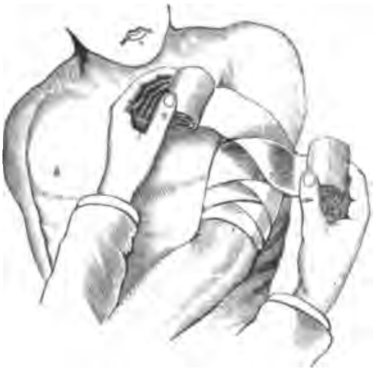


FIG. 48.—*Double-headed Spiral with Reverses.*

As has been implied, this bandage may be employed in almost all the cases in which the turned bandage is generally used, and it is often really preferable, being not less firm and yet more elastic, but as a rule its employment is confined to the neighbourhood of joints, so that if a limb *and* a joint, or joints, have to be bandaged, say the ankle, leg, knee, and thigh, there would be a turn or two placed round the foot, then the ankle would have the figure of 8 (leaving out the heel), the leg the turned (See Fig. 47), the knee the 8, and the thigh the turned again.

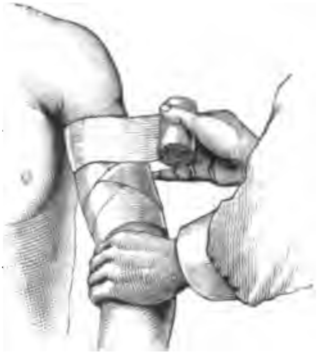


FIG. 49.—*Application of the Figure of 8 Bandage to a Limb.*

One practical reason for this changing is that the figure of 8 requires twice as much bandage to cover a limb as the turned spiral does.

The 8 bandage is also used for joints, simply as one or two turns, crossing over the centre of the flexor aspect of the joint. (Fig 50.) This pattern is useful in a number of cases, which may be imagined.

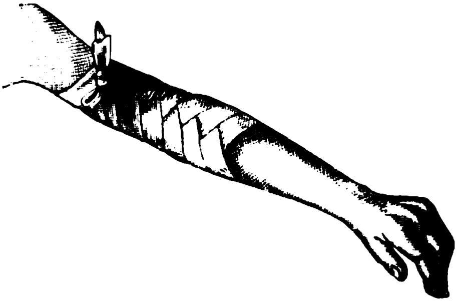


FIG. 50.—*Figure of 8 for bend of Elbow.*

To cover the heel or elbow.

The point of the heel, and the *point of the elbow*, with their respective joints, may be completely covered by a series of enlarging figures of 8, starting from the centre, having the crossing placed over the front of the joint, and the loops above and below the line drawn from the middle of the front of the joint to the heel or the olecranon, and getting always more and more open, and further away from the middle line as the bandage progresses. (Fig. 51). In this way the elbow may be conveniently bandaged. The heel pattern is nearly or quite the hardest one to adjust of all the common forms. It is very neat looking, but it is seldom worth the trouble of its application save as an exercise in bandaging.

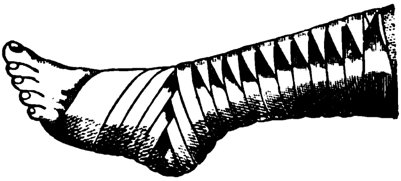


FIG. 51.—*Bandage taking in the Heel.*

The spica bandage.

The spica (spike or *spathe,* a botanical term applied to heads of seeds arranged as in an ear of wheat) is extremely useful for applying firm pressure to joints, or fastening dressings over them. The pattern is the same, whether the bandage be applied to the shoulder, groin, thumb, or great toe, and is that of a figure of 8, combined with a firm attachment to a limb in the neighbourhood of the joint,—the wrist for the thumb, the arm for the shoulder, the thigh for the groin, and the ankle for the great toe. Taking the *spica of the groin* as an example (Fig. 52), the bandage begins

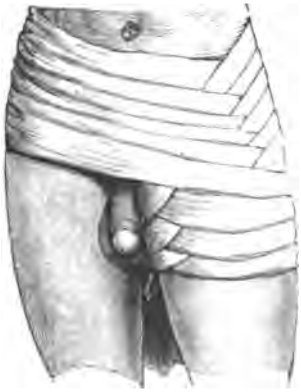


FIG. 52.—*Spica of Groin.*

Spica of groin.

by two or three reversed turns from within outwards (or overlapping 8's) round the top of the thigh. The bandage is then carried outwards over the groin to just below the anterior spine of the ilium, and then round the back, taking care to keep just below the iliac crest. The bandage is then brought obliquely across over the symphysis pubis, crossing over the starting point to reach the outer part of the top of the thigh, and is then passed round it, and brought up ready to repeat the roll, but this time a little lower down, and so on till the groin and hip are sufficiently covered. The hip should be very slightly flexed at the time, and care must be taken not to slip on to the abdomen with the bandage, as it is passed round the brim of the false pelvis.

Double spica.

With a long bandage the spica may be easily enough applied to both groins, starting from one side and repeating every manœuvre on the other before returning; but in practice this is a bandage very rarely used, and requires mention only. The principle of the spica being understood, a detailed description of the different applications of the pattern is not called for, and the especial points only will be noticed. *The spica of the shoulder* is an extremely firm bandage (Fig. 53); the starting point is taken from the upper arm, the turns being rolled round as high as the axillary folds will allow. The bandage is then brought through the axilla, and over the shoulder and round

Spica of shoulder.

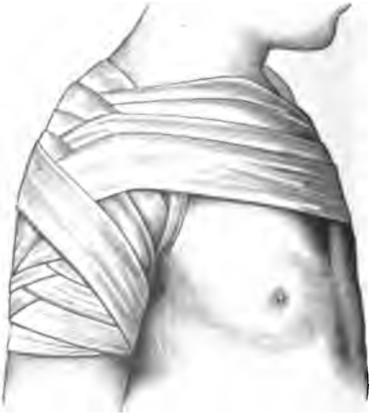


FIG. 53.—*Spica of Shoulder.*

the chest, passing under the opposite armpit, and the crossing of the first turn should go as high up upon the shoulder as the bandage will lie. The succeeding turns will come successively lower and lower down, until the shoulder is covered in. This pattern requires a long bandage, and it may, as in the case of the groin spica, be doubled for both shoulders if required.

Spica of thumb.

The spica of the thumb (Fig. 54) is the regular bandage for the common sprain of that joint. As with the bandages for the phalanges, the roller must be quite narrow, not more than three-quarters of an inch wide. The spica is begun with a few turns round the wrist, from within outwards, if the outside of the thumb is to be the most supported, and the reverse if the ball be the part requiring the firmer pressure. It is then taken round the thumb as high as the bandage will lie, and the succeeding turns lower and lower (as in all spicas), till the ball is covered. It is then fastened round the wrist either by a safety pin, or by splitting the end of the bandage into two tails, which are tied together.

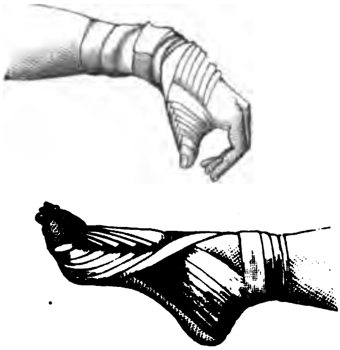


FIG. 54.—*Spicas of the Thumb and Big Toe.*

Spica of big toe.

The spica of the big toe (Fig. 54) is applied in precisely the same way, the ankle standing in the place of the wrist. It is, however, more difficult to apply without getting an awkward quantity of bandage material between the toes.

The finger bandage.

The fingers may sometimes be sufficiently covered with a simple spiral bandage, or with reverses, or 8's, using a narrow bandage with neat edges, commencing at the tip, and finishing off at the root of the finger.

But, as a rule, to bandage the fingers or the whole of the thumb efficiently, a combination of spirals and 8's with the spica is required. Taking the forefinger as an example (Fig. 55), the bandage is fixed by a few turns round the wrist, and is then brought up across the back of the hand from the radial side of the wrist (or along the palm from the ulnar side if preferred), and is passed between the fore and middle fingers, and half round the former as if to make a spica. Instead of completing the 8, however, the bandage is carried in a bold spiral up to the tip of the finger, which is then bandaged carefully downwards to the root. This may be done with simple close spirals, or with small 8's, or reversed spirals if the bandage be wanted to look very neat. The bandage is then finally brought out between the fore and middle fingers, and descending, is crossed at the knuckle over the ascending portion, to go to the ulnar side of the wrist, round which it is fastened in the usual way.

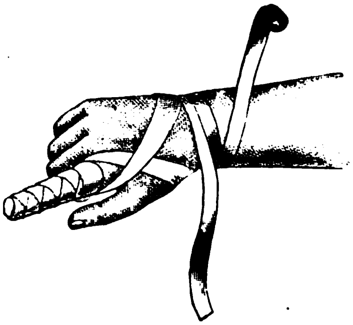


FIG. 55.—*Finger Bandage.*

To bandage all the fingers.

If the description has been followed, there will be no difficulty in understanding how *all the fingers* may be bandaged successively in the same way (Fig. 56) with one bandage, by starting round the wrist as before, and going

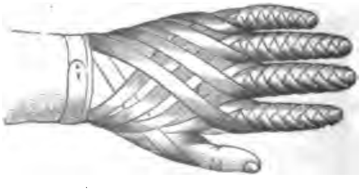


FIG. 56.—*Bandage for all the Fingers.*

over first to the little finger, then round the wrist, then to the ring finger, and so on. In this way the palm is left free, and the back of the hand covered, but if it be desired to cover the palm and leave the back of the hand, this is readily done by starting from the ulnar side of the wrist and going across the palm to the thumb or forefinger, as in the case of the single finger. As a rule it is convenient to make a separate bandage of the thumb, but it may be included if desired. In any case a long bandage, not more than ¾ inch wide, must be chosen, and unless the bandage be soft, and have clean-cut unfrayed edges, it can hardly be made to look very neat.

The principal use of this pattern is as a precaution against œdema of the fingers; it is not so often put on now as it used to be.

To bandage a stump.

All applications of a roller bandage to a conical part must inevitably be somewhat insecure unless put on very tight, and this is generally unwise. It is therefore difficult with any form of roller bandage to apply exactly the amount of pressure which is deemed desirable to an amputation stump, and yet have the bandage secure against slipping off. The *bandage for a stump* (Fig. 57) is a pattern known as the *recurrent* bandage. The roller for this should never be more than two inches wide, and for an amputation of the arm, or for a "Syme" it may well be still narrower. The bandage is first attached three or four inches above the stump by one or two circular turns, and then, the thumb being placed over the middle of these turns in front, and the forefinger similarly behind, it is brought right over the face of the

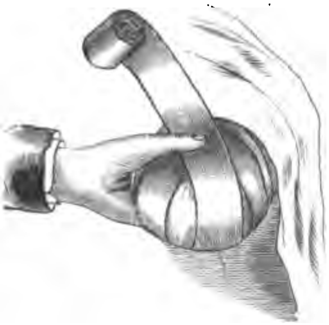


FIG. 57.—*Recurrent Bandage for Stump.*

stump from the middle line in front to the same point behind. This reverse is kept in its place behind by the fore-finger, and the bandage is brought back again, now a little to one side of the middle, but converging to that point when it reaches its starting point. This is then fixed by the thumb, and the bandage is brought over again, passing this time to the other side of the middle line, and converging to it behind. These reverses are continued till the whole stump is covered, and then by one or two firm circular turns they are fixed in the position in which they were held by the thumb and finger, as shown in the figure. It is often wise to make a circular turn or two in the course of making the reverses, so as to fix those already made, but in bandaging a stump, the dresser must avoid making the parts hot by unnecessary folds of the roller. This pattern may also be put on so as to cover half or all the head, and may be made tolerably secure if care be taken that the circular turns are kept low down on the forehead and well below the occipital protuberance.

The double-headed roller for stumps, or for the head, the capeline.

Amputation stumps and also *the head* may be bandaged by a method which although it results in a pattern which looks like the recurrent, is yet different in principle, and firmer—namely, by the use of a "double headed" roller, a bandage, that is, both ends of which are rolled up towards each other in the centre. This is the bandage which when applied to the head is known as the "capeline." The application for a stump is the same in all respects. To put on the capeline it is more convenient for the patient to be sitting. The surgeon standing behind takes one head of the roller in each hand (Fig. 58), and places the middle of the bandage on the forehead. The two parts are then brought round

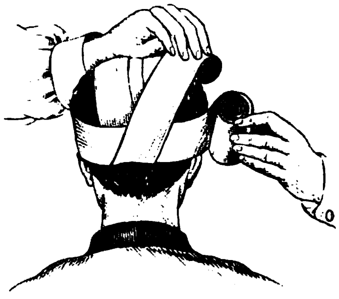


FIG. 58.—*Double-headed Roller, or Capeline.*

and crossed below the occiput. One of the ends is then continued round, and the other, which is lying below it, is turned up and brought over the head as in the "recurrent" bandage. It is now met by the other half of the bandage which has gone round the head, while this half has gone over it, and the former continued round, fixes the bandage so that it can again be brought over the head, when the manœuvre is repeated. In this way by adjusting the subsequent turns of the bandage alternately to one side and the other of the first one, which was in the middle, either half (Fig. 59) or the whole of the head may be covered with folds converging to the middle line in front and behind, and a somewhat attractive bandage is made. Its appearance is, however, almost its only good quality. It is firmer than the simple recurrent bandage

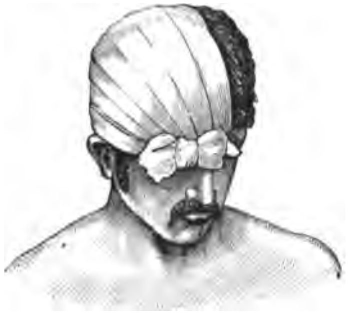


Fig. 59.—*Capeline for Half the Head.*

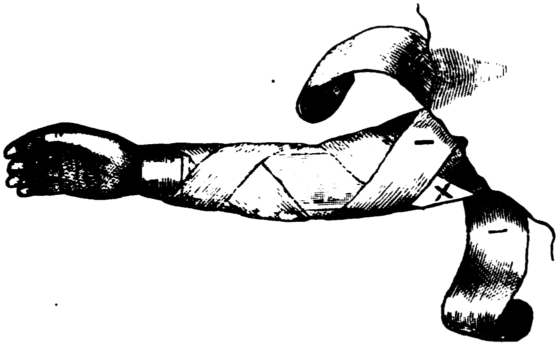


Fig. 60.—*Double Spiral Bandage.*

but is still very liable to slip. It is troublesome to apply, hot, and if at all tight round the head, apt to become painful, while it fulfils few indications which cannot be at least as well met by the more homely, but far more comfortable triangular bandage. When applied to a stump, however, it may sometimes be useful.

Double spiral. Another application of the double headed roller which is not often used in this country may here be mentioned, namely, the *double spiral* (Fig 60). The two spirals crossing each other in front and behind, make an open bandage which is convenient enough for retaining dressings.

The knotted bandage. The *twisted or knotted* bandage for the head (Fig. 61) is generally described as one which requires a double headed roller, but this is not at all necessary or desirable. It is an extremely useful bandage, and is easy to apply. For example, taking the neighbourhood of the temple as the situation in which the pressure of the twist is required, the bandage should be unrolled for about a foot, and the end held in the right hand, which is kept close to the temple. The roller is then carried round the forehead and occiput, so that it comes back to the unrolled end at the wound. The roller is then twisted round sharply as shown in the figure, and is carried down below the chin and round to the vertex. On coming to the temple again the same twist is made, and the roller is once more passed round horizontally; when sufficient pressure is obtained, the bandage is fixed by knotting the two ends together.

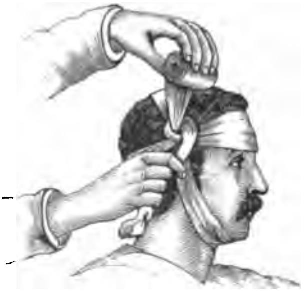


FIG. 61.—*Twisted Bandage for Head.*

Four-tailed bandage. In discussing the treatment of fractures of the lower jaw, the *four-tailed bandage* will be again referred to, but it may properly be described here. It is a very useful pattern and serves for the attachment of dressings in wounds about the chin or face, as well as for fractures. For the bandage (Fig. 62), a piece of shirting four or five inches wide and two feet long is required. It is then doubled on itself and torn down, until a piece four inches long only is left undivided in the middle. In the middle of this a slit two inches long is generally cut, in which the point of the chin is inserted, but this is often omitted.

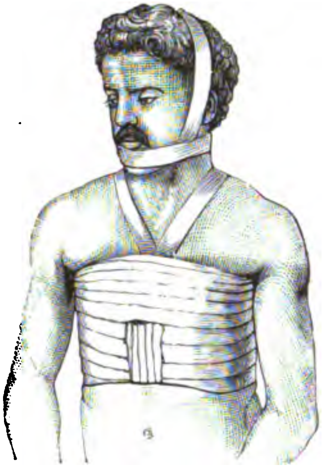


FIG. 62.—*Four-tailed Bandage for Jaw, with Chest Bandage.*

The middle of the undivided part is placed over the chin, and the under pair of the four tails made by tearing the bandage are then brought up over the side of the face in a line with the masseter muscle, and loosely knotted or held half an inch in front of the vertex of the skull. These pass underneath the other pair, which are brought round to just beneath the occipital protuberance, and firmly tied together with a reef knot. The first pair on the vertex are then tied with sufficient firmness to fix the lower jaw against the upper one; and finally the vertical part is kept from slipping forwards, and the horizontal from slipping downwards, by tying the four tails together (this is not shown in the figure). In adjusting this bandage it is necessary to see that the length of the undivided part fits the jaw to which it has to be applied, and this can only be done by trying it on before it is finally fixed.

Chest bandage. In bandaging the chest there is a tendency for the bandage to slip down on account of the decrease in size of the thorax from above down. This is best overcome by using a brace and bandaging from below upwards. A piece of bandage should be split in the centre, and the head passed through the opening, so that one end hangs down in front and the other behind. The bandage should be applied over this, being fixed by one or two turns round the chest, and then carried up with a reverse in each turn, thus overcoming the tendency to form an open spiral. Finally, the two ends of the brace should be brought up and fixed (Fig. 62).

Breast bandage. The roller is first fixed by a couple of turns round the chest, starting from and below the affected gland; it is then carried upwards over the lower part of the breast and the opposite shoulder, descending across the back to the original starting point, then horizontally round the chest. These turns are then repeated, each oblique turn being fixed by the succeeding horizontal one, and rising higher on the breast until it is covered. It is important always to bandage from the affected side (Fig. 63).

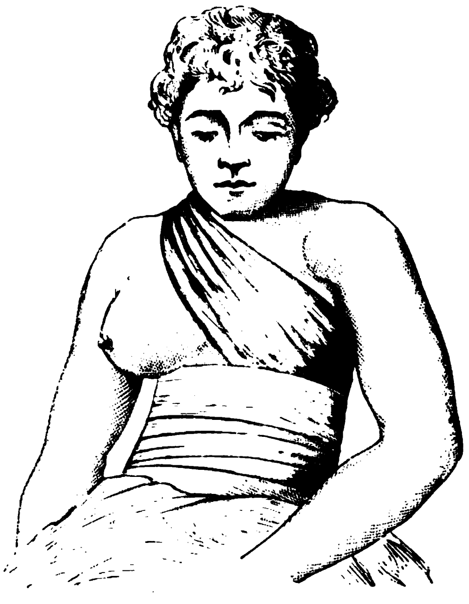


FIG. 63.—*Breast Bandage.*

The *single* T *bandage* (Fig. 64) is most frequently used for fixing dressings to the perinæum. Its application there is simple enough. The horizontal part being fixed round the waist, the other end is brought round between the legs and fastened in front.

The single T bandage.

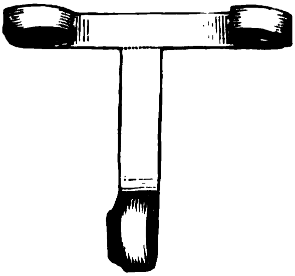
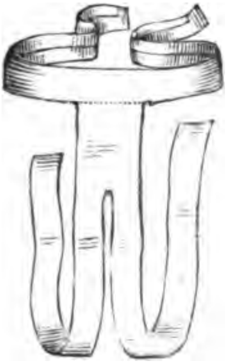


FIG. 64.—*Single* T *Bandage.*

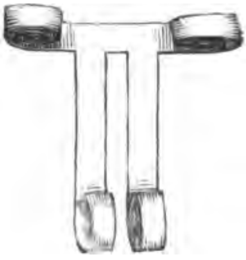
The bandage can also be applied to the head or elsewhere. For the perinæum a good average size is five feet for the horizontal piece and three feet for the vertical, and it should be about three inches wide.

For the perinæum, a better pattern than the single T is the "*double* T" complete (Fig. 66), or incomplete (Fig. 65).

The double T bandage.



The double T *incomplete.*
FIG. 65.



The double T *complete.*
FIG. 66.

The latter is made from the single one by tearing the perpendicular portion into two tails, except for five inches behind. By using either of these bandages the awkwardness of bringing up the single vertical piece in the middle line in front is avoided.

The St. Andrew's cross for the perinæum.

This will be a fitting place to describe a perineal bandage which is very convenient for keeping dressings upon the pubes and perinæum without the necessity of displacement for the performance of their natural functions.

The principle of its application can easily be understood from the following illustration (Fig. 67), and it is known as the "St. Andrew's Cross."

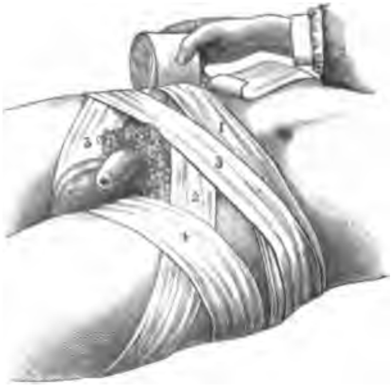


FIG. 67.—*Bandage for the Perinæum.*

If, as in the illustration, the bandage is to be put on from the patient's right side to the left, from the front, or standing over him if he be lying down, the bandage is first fixed by a turn or two round the pelvis, from right to left (1), then carried from the right anterior spine of the ilium diagonally downwards across the left groin (2), then around the left thigh upwards between the thighs to the right spine (3), then around the pelvis posteriorly to the left spine, from which point it is carried down between the thighs (4), and around the right buttock and upwards across the right groin to the left spine (5), and around the pelvis to its starting point at the left iliac spine, these turns are then repeated.

The T is also a very good bandage to apply to the head, to retain dressings. If used *for the head* the vertical slips should be two feet long, and the horizontal one about a yard and a half, to allow of its going round the head twice or thrice. The width should be three-quarters of an inch.

For the nose a good bandage is the double T, applied as in Fig. 68, or the single T with a slit in the vertical part, of the requisite size to partly admit the nasal prominence; while if, in addition, a slit be made in the middle of the horizontal part of either the single or double T for the mouth, it becomes a good bandage for the application of dressings *to the lips* (Fig. 69).

Double T for nose and mouth.

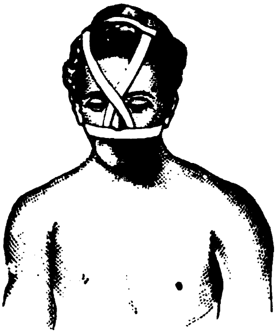


FIG. 68.—*Double* T *applied to Nose.*

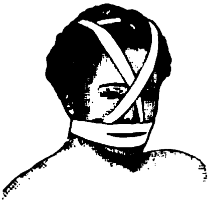


FIG. 69.—*Double* T *Bandage for the Nose and Mouth.*

The single or double T, or a T with a small triangular piece inserted at the junction of the vertical and horizontal portions, makes a good bandage for the ear, and other modifications may be easily imagined.

T bandage for ear.

OF KNOTS.

Among the smaller but necessary accomplishments of the complete surgeon must be reckoned the art of making a "reef," "bow," or "slip knot," or a "clove-hitch," neatly, quickly, and firmly. The importance of this need not be insisted on, for in surgery very literally and very often it

The principal kinds of knots.

happens that life hangs on a thread, and the results may be disastrous if this be insecure. But we believe that to describe in words the actual movements of the fingers in making these knots would be only waste of time; it is a knowledge which each student must acquire for himself by practice after he has been shown how to do it.

The reef knot.

In Fig. 70 the left hand cut shows a cord tied in a *reef-knot*; the right hand one in a *granny*, and the under ones in a *clove-hitch*, which in the left is half made, and in the right is shown completed, by placing the loop A in front of loop B. Where firmness is wanted, as for the ligature of a vessel, and for all ordinary purposes of knotting, the *reef* is the one for surgeons to use—the *granny*, never—and the dresser must go on practising the manœuvres until his fingers acquire a perfect automatic skill, so that he never has to think of their individual movements. The *clove-hitch* is very useful when a pull upon any part is required; as for example, in dislocations of the shoulder, when a jack towel is fastened by this knot round the arm. Its great advantage is that it gets firmer the more it is pulled upon, while yet it can be loosed in a moment. Moreover it has no tendency to slip, like a noose. There are one or two ways of making it, all practically coming to the same thing, but the main idea and purpose of the knot can be gathered from the figure.

The clove-hitch.

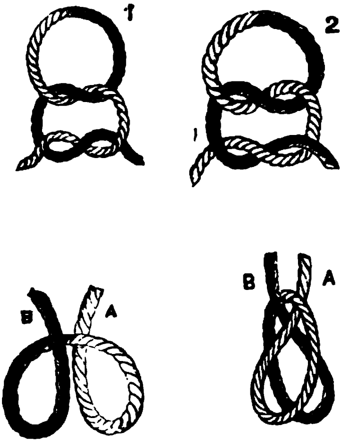


FIG. 70.—*Reef, Granny, and Clove-hitch Knots.*

The Staffordshire knot.

Neither time nor space need be wasted in discussing the virtues of the bow or half bow; other knots well known to sailors or builders, as the carrick bend, the bowline, weavers' knot, etc., are not used in surgery, but what is known as the "Staffordshire Knot" is a very useful one for securing the cut end of a vascular pedicle by transfixing it with a double-threaded needle on a handle, and slipping the loop over the stump down to the entrance of the threads into it (the needle having been withdrawn). One of these entering threads passes over and the other remains under the loop, so that they can be tightened, one first and then the other, and lastly must be tied in a reef knot, so that both halves of the stump are simultaneously but separately constricted by the single string and knot (Fig. 71).

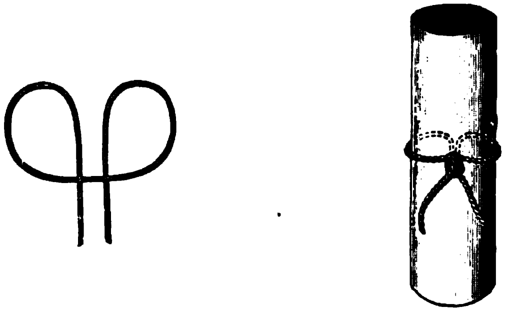


FIG. 71.—*Staffordshire Knot.*

CHAPTER VIII.

OF ELASTIC BANDAGES, TRUSSES, ETC.

Of elastic bandages generally.

Elastic bandages may be employed simply for support, or for some more definite object, as the absorption of fluid or the subduing of inflammation. It must be borne in mind that continued compression will surely bring about wasting, and if the circulation be interfered with, this wasting by absorption may be very great. The fact is sometimes taken advantage of in surgery, as when an elastic ligature is used to cut through a fistula in the dangerous region of the rectum, but it may also through neglect be the cause of surgical disaster, and even the moderate compression of an elastic stocking is sometimes found to be productive of mischief.

Martin's bandages.

The indiarubber bandages, lately brought into notice by Dr. Martin, mark a distinct advance in the treatment of several morbid conditions, especially those due to impaired venous circulation, as varicose eczema, or ulcers of the legs, or of œdema elsewhere. They are used also in the treatment of more active inflammatory swelling, and in the dressing of operation wounds, as for example, after an excision of the breast where it is desirable to make a firm but gentle pressure upon the parts. These bandages are made of a special kind of rubber, and are of the lengths and widths of ordinary rollers. Before applying them, the limbs should always be raised for some time. The hour of rising is, therefore, the best time to put them on. These bandages are put on in the same way as the common forms, but it is easier to apply them too tightly than the reverse, for they stretch so readily that the amount of compression actually exercised is apt to be under-estimated. They should never be applied directly to a moist eczematous surface or to an ulcer. Oil speedily rots them.*

Woven elastic bandages.

Lastly, there are several varieties of woven bandages which are more or less elastic, and may be used for the purposes above mentioned fairly satisfactorily. All these may be applied as simple spirals without reverses.

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* A very elastic felt bandage is made by Ewen, of Jermyn Street, which fulfils in many ways the object of the indiarubber bandage, and has the advantages of a woollen stuff. The bandage does not, however, wear well.

Elastic stockings, etc.

For the purpose of supporting varicose veins, or joints weakened as the result of sprains or fractures in their neighbourhood, various forms of woven stockings, knee-caps, etc., are made in silk or cotton, and may often be very usefully employed. The drawback to their continuous use is their tendency to waste the muscles, and to hamper the free play of the joints. They should not, therefore, be prescribed haphazard.

The following are the measurements to be taken at points corresponding to the letters given here and in the accompanying diagram (Fig. 72) for the principal forms of elastic supports:—

For Anklets, the circumferences at A, B, and C; for Stockings, the circumferences A, B, C, D, and E, and the length from B to E; for Knee-caps, the circumferences at E and F, also that round the centre of the knee; for Thigh-pieces, the circumferences at F and G, and the length required; for Belts, the circumferences at H and K, and the depth required in front and behind; for Wristlets, the circumferences at L and M.

Suspensory bandages.

Of *suspensory bandages* there are several patterns in silk and cotton, and no directions as to their choice are necessary, further than that care should be taken that they fit, and that there is no chafing between the scrotum and the groins.

Although they are frequently worn by people who do not require them, they are useful in cases of simple laxity of the dartos tissues, so common in hot weather, in slight cases of varicocele, and should be worn in all cases where hydrocele is present, to prevent the unpleasant dragging of the distended tunica vaginalis. They also certainly prevent the sac from filling as quickly as it otherwise would do.

Abdominal belts.

In London, and probably elsewhere, a bad habit prevails among labouring men of wearing a broad webbing belt, stiffened with steel or whalebone, round the abdomen, with some hazy idea that they thereby save the muscles of the back. Of course, any result in this direction must be a weakening, by impeding free muscular play, but these belts are, in addition, very important agents in the causation of hernia by concentrating the outward pressure of the contents of the abdomen upon the weak places in its walls. Where, however, the abdominal walls are lax and pendulous, especially in fat women, a well made abdominal belt is often

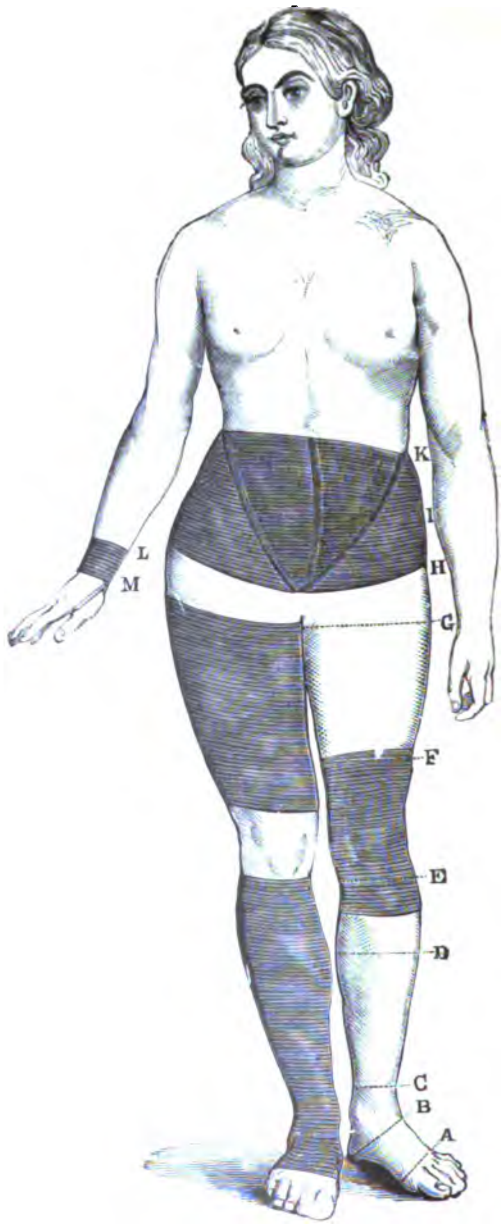

FIG. 72.—*Figure showing the chief Patterns of Elastic Stockings, Belts, &c.* (From Wright's Catalogue.)

necessary, and is far better than any form of stays. In fitting the belt, the points to be attended to are that it should be so applied that the line of support is *upwards*, and that some elastic material forms a part of the belt, so that there is nowhere a rigid constriction. These belts should always be laced.

Trusses.

This will be a convenient place to speak of those very important surgical appliances—*trusses*, which every student should know how to measure for and apply; for while a well fitting truss should in most cases absolutely remedy the inconveniences and dangers of a rupture, a badly fitting or a badly adjusted one is a positive risk to the wearer.

Broadly speaking, a truss is a pad connected with a spring, by means of which an aperture or weak place in the abdominal walls or elsewhere is rendered as strong as the rest, or by which (as in cases of irreducible scrotal rupture) a portion of the contents which have protruded may be supported and guarded from injury.

It may be said that every hernia of the intestines through any part of the abdominal walls calls for the support of a truss, however slight may be the protrusion; but it does occasionally happen that great difficulties exist in the way of their application through the hernia being complicated with a malposition of the testis.

The different kinds.

Trusses may be divided into ordinary and special forms. The ordinary form of trusses are inguinal, femoral and umbilical, and the two former may be double or single. The special forms are scrotal, obturator, vaginal, etc.

OF THE FITTING OF INGUINAL, INGUINO-SCROTAL, AND FEMORAL TRUSSES.

Of inguinal and femoral trusses.

It is not sufficient for the surgeon to content himself with taking the measurement an inch and a half below the brim of the pelvis of a patient with hernia, and then to order a truss; nor should he leave the question of the kind and strength of the instrument to a surgical mechanician. He should be able to state precisely the sort of truss required, the best kind and shape of pad, etc., and should further not only be able to recognise when a truss does not fit, but to know exactly where and in what the failure consists.

There are very many varieties of trusses differing from each other in the shape and spring of the pad, in the nature of the spring, in their covering material, and so on, but putting aside fantastic patterns they will all be found to consist of a circular spring made of one piece of tempered steel, with a pad attached directly to it. In one form in common use only, the "Moc-main," is the principle of the circular spring absent, and this kind is not recommended. The spring must be light and elastic, and of just sufficient strength to retain the rupture, neither allowing it to descend behind the pad, nor exercising such pressure as might serve to weaken the hernial aperture. The spring must further fit and *cling* round the pelvis just below the iliac crest, and above the fleshy parts of the glutei, which, by their working, would move it up and down if it were in contact with them. It must especially fit flat to the base of the sacrum when the pad is in position against the rupture.

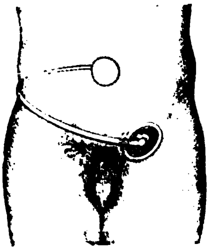

FIG. 73.—"*Single Truss,*" *Salmon's.*

According to some patterns it here terminates in a flat pad (Fig. 73), in others the spring is continued round until two thirds of the pelvis are encircled, as in Fig. 74 (we are speaking of single trusses only), but in either case the circle

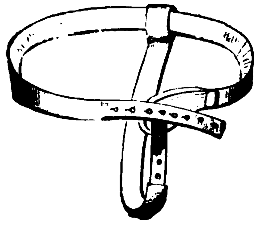

FIG. 74.—*Ordinary Circular Spring Truss.*

of the pelvis is almost always completed by a leather strap which comes round and is fastened to the upper of two studs which are found on the pad.

It will be seen, therefore, that the truss spring though it be termed "circular" must never be a segment of a circle, but must consist of a combination of curves, different in different patients. Thus one with large muscular buttocks, with the glutei coming right up to the top of the crest, will require the spring to be more open round the ilium, and to take its bearing chiefly from the base of the sacrum, while in a spare person it should lie close up against the bone everywhere.

Strength of spring.

The *strength* of the spring will vary according to the ease with which the rupture can be restrained, the presence or absence of habitual cough, and the occupation of the wearer. A city clerk will not require one of the same strength as that suited for a vintner's porter or a navigator. Speaking generally, the spring must exert a sufficient, but only a sufficient pressure inwards when the wearer is at rest, but this pressure must quickly and greatly be increased with any increase of the outward pressure of the rupture.

Although the shape and strength of the spring must differ in different people, most cases will be found to fall into one of two or three types, so that an instrument maker who understands the principles of truss fitting will not require to make one especially for every patient; but in all cases of difficulty or peculiarity the spring must be hammered up to the shape of the wearer previous to a final tempering. If any alteration be required it is easy to render the metal again sufficiently malleable to effect the change, and once more to stiffen it.

The pad.

The *pad* should be firmly attached to the spring, and its upper edge should be a continuation of the down sloping line which the truss should take from the bend below the front iliac spine. The direction and shape of the rest of the pad vary according as to whether the rupture be inguinal or femoral, the size of the aperture, etc., but it is generally pear shaped, about two and a half inches long, and two inches wide. Upon its outer surface are two studs, the upper one for the attachment of the encircling strap, the lower one for the thigh strap. The inner surface of the pad should be nearly flat, and must in most cases be directed slightly upwards.

There are a great number of pads in use, differing more or less from each other. For labouring men and hospital patients probably the best is a leather cushion well stuffed with hair. Coles' trusses have a coiled spring within a metal shield which yields to the movements of the wearer, and itself exerting pressure enables the truss spring to be very light; it is a very good pattern both of truss and pad (Fig.

75). Other pads again are made of solid indiarubber, or of wood, or of indiarubber inflated (air pads), or filled with glycerine, etc.

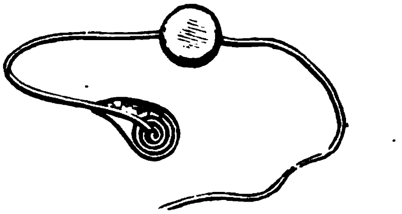

FIG. 75.—*Coles' Truss showing Spiral Pad.*

The truss generally, but especially the pad, should be able to be kept easily clean, and must not absorb the sweat. In warm weather, adults as well as children will find starch, or violet powder, or fuller's earth very useful. Another good plan is to have a set of cotton covers made to slip over the pad, which can be changed and washed as often as may be required.

The thigh strap. The *Thigh strap*, an important part of the truss, is intended to prevent the pad slipping up when the wearer is moving. It should be fastened round the spring just behind the bend of the "shoulder," (*i.e.*, below the front of the iliac crest) and running in the fold of the buttock come up in front through the fork and be attached to the lower of the two studs on the pad, as before mentioned. It should be adjusted so as to be just felt to be tight when the wearer is standing upright.

Inguinal trusses. The special points to pay attention to in connection with trusses for inguinal and inguino-scrotal herniæ are, to see that the pad presses over the internal abdominal ring and over the canal, as far as, but not beyond the external ring, and that the surface of the pad directly opposes that of the protrusion. This will vary in different cases, but will generally be downwards and inwards. Under no circumstances should the pad ever touch the pubes, and if for any reason it has to extend over that bone it must be fashioned with an indentation to avoid contact.

Femoral trusses. In trusses for femoral herniæ the chief characteristic is in the direction of the pad; instead of being directed obliquely downwards and inwards, it falls almost vertically, so as to lie along the femoral canal; the encircling spring also should fall more decidedly from the "shoulder" below the iliac spine. The top stud, for the attachment of the belt which completes the circle of the spring, must be placed quite at the top of the pad, or upon the spring itself, and the thigh piece must have its stud at the bottom of the pad, so as to keep the latter well down.

Double trusses.

It was formerly not an uncommon practice for *double* trusses to be worn for single herniæ with the notion that the development of a possible second hernia was thereby prevented. The practice is a bad one, for pressure where it is not required only weakens the part by absorption. If symptoms of hernia, however, are present on both sides, the principles of the application of a double truss are the same as those we have just stated, but the spring will now run round from one pad to the other, and the two will be connected by a small cross strap. Two thigh straps will be required, one for each side.

Trusses must be worn continuously during the day (unless the patient be lying down) and taken off only on getting into bed. In cases of chronic cough it may be advisable to wear the truss day and night, and in this case it should be taken off morning and evening and the skin powdered.

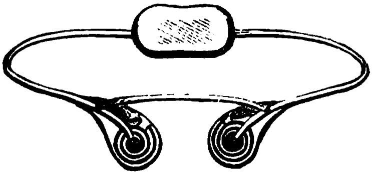

FIG. 76.—*Double Truss (Coles').*

Scrotal trusses.

In cases of rupture, where the hernia is very large, and descends through a large aperture into the scrotum, a truss with a specially made supporting pad will have to be employed. The exact shape and direction of the pad will

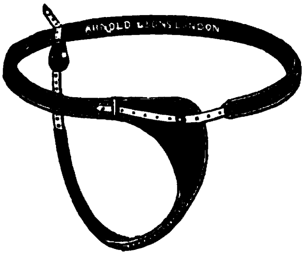

FIG. 77.—*Truss for Scrotal Rupture.*

vary in each case, and the truss has to be made much stronger than for ordinary ruptures. Further, it will often be found that the rupture is not returnable, in part or altogether; it is then termed *irreducible*, and a cup shaped pad must be fashioned for its support.

Mr. Bryant advises (*Brit. Med. Journal*, i., 1884, p. 307), that to ensure an accurately fitting support for such a rupture, a "mould" should be taken of it in plaster of Paris, and, that from this a "cast" made of the same material, upon which a cup shaped support may be struck up out of a sheet of tin or copper, which will be the exact counterpart of the protrusion, and support it everywhere. It must be lined with chamois leather.

Trusses for infants.

The question of fitting trusses *on very young infants* is often a difficult one to decide. Undoubtedly some infants badly ruptured are too weakly to bear even the moderate pressure of a truss, but we believe that if the instrument be light, and properly fitting, this will very rarely be the case, and it should be borne in mind that in infants a good truss is frequently a means of cure, that indeed, cure generally takes place if the rupture be the ordinary congenital hernia into the vaginal process. The rule, therefore, should be that, in the absence of special reasons to the contrary, at no age is a truss contra-indicated, though undoubtedly in newly born children great care will have to be taken to prevent chafing, in consequence of their incontinent habits. The trusses for infants should either be "Coles'" or some similar light pattern, covered all over with india-rubber, or of a kind which has been recently introduced, in which a flexible india-rubber *belt* (no spring) goes round the pelvis, and is connected with an air pad, of which there are different shapes.

Worsted truss.

Mr. Lund,* in 1885, advised the use of a worsted truss, which was at that time little, if at all, used in London. It was first described in the *Medical Gazette* in 1848, by Mr. William Coates, who learnt its application from a "gudewife in the neighbourhood." It consists of a skein of lambs' wool (for infants Berlin wool is preferred), which encircles the pelvis over the inguinal ring. One end of the skein is passed through the loop of the other, and then carried between the thighs and fastened behind to that part which forms the cincture. Mr. Coates says (*loc. cit.*) that this truss uniformly effects a cure in infants, and that the pattern is useful in emergencies, for adults; two silk handkerchiefs tied in a ring being employed.

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* In "Hunterian Lectures," 1886, or "Brit. Med. Journal," 1885, i., p. 1848.

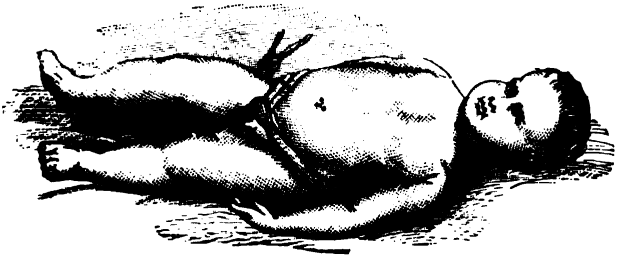

FIG. 78.—*Worsted Truss for Infants.*

Fig. 78, lent me by Mr. Lund, gives a representation of this way of trussing infants, the value of which is now getting better known than it was a few years back.

It has just been stated above that many cases of infantile hernia get well of themselves, and that others will get well under spring trusses, or mechanical trusses of other kinds. There is no surgeon of any experience of these cases who does not know that if infantile ruptures are continuously retained completely within the abdomen they will get well, and that very quickly, whatever form of truss is adopted—unless some persistent cause exists which favours the descent of the hernia, such as whooping cough, phimosis, calculus, prolapsus ani, etc.

But mechanical trusses have undoubted drawbacks in the quickness with which they are, by the rapidity of infantile growth, rendered inefficient, in the difficulty with which they can be kept clean, and if spring trusses, in their liability to break, and the ease with which the tender skin becomes sore from their use.

The favourable results which have attended an almost exclusive adoption of this plan of trussing infantile cases, with a worsted skein up to their reaching eighteen months, and very frequently through the third year, have only served to strengthen my conviction of the value of a plan which I have now followed for several years.

There are certain points of detail to which it may be worth while drawing attention. First, a good deal depends upon the kind of wool, or rather of worsted, employed—for, although the two words are often used indifferently, wool and worsted are not the same things, the latter having a much greater twist. Real Berlin wool I have found not to wear well; it does well enough when new, but spoils in one or two washings. "Alloa yarn" or "five-ply or four-ply fingering" on the other hand, are improved for the purpose of these trusses by washing, and they are not too harsh for the skin of any except the tenderest infant, in whose case a skein of "lambs'-wool" does best.

Nothing except wool or worsted seems to act as an efficient truss when applied in the same way; this is due, no doubt, to the elasticity of the animal fibres, which is distinct, although limited. In some cases in which the ruptures were large, and occurred in children between three and five years of age, I have found it useful to increase the elasticity by using, instead of the simple skein, a loop of the same material loosely knitted, or crocheted into a flat band about two inches wide, and applied in the same fashion.

I doubt whether a skein of twenty threads only, as Mr. Lund advises, will be found thick enough, except for very small infants, and I have sometimes found it necessary to use as many as double that number. It must be clearly understood that no pad of any sort is to be worn underneath the loop. Nurses often make this mistake; indeed, as to the whole method, some little patience will be called for in order to secure that it shall be carried out intelligently, or disappointment will surely ensue. But this patience will not be thrown away if the end is gained of saving mothers from the endless worry and expense which a ruptured infant so frequently entails upon them; and if I seem to be needlessly particular as to details, it is because I am convinced of the value of this old-fashioned treatment, and am anxious that it should not get discredit from lack of fulness of description.

The circumference of the skein runs from three feet to five feet, *i.e.*, the loop is from eighteen inches to thirty inches long,* and a fresh skein should be put on every morning, the soiled one being rinsed out and hung up to dry.

Predisposing causes of hernia in infants.

Two great predisposing causes of rupture in infants may here be mentioned. One is the foolish habit of sewing a tight abdominal "binder" round the unfortunate baby; the other is the frequent occurrence of phimosis. It will often be found that a rupture will undergo spontaneous cure after circumcision, and although on this account the application of the truss should not be postponed, still the operation, always advisable in phimosis, or when the foreskin is long, becomes the more urgent when the child is also ruptured.

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* I may here refer to a paper by myself which will be found in "Brit. Med. Journal," 28th May, 1887. Also to Mr. E. Owen's "Lettsomian Lectures," in 1889 (Baillière).

Though it may seem superfluous, it will be found not infrequently necessary to caution mothers against putting on a truss over the neck of a rupture when it is down, instead of returning it first.

Umbilical hernia.

Umbilical hernia in infants is extremely common; in children it is less often met with, and in adults, especially in corpulent women, it is not infrequent. In the latter, however, it is more common to find the bowel coming through a little to one side of the true umbilicus.

In children this condition can usually be cured readily enough by wearing a spring truss, or what is much more common, a belt with a pad in front.

A better way of treating this affection in infants, however, is to fix a pad made of a piece of cork, covered with lint, over the navel with pieces of strapping. Care must be taken that both this pad and that of a truss are sufficiently large to press *upon* the aperture, not to fit *into* it, or absorption of its margin may take place.

Umbilical herniæ in adults should always be supported by a truss, for though their aperture is generally large, they are as liable as others to become strangulated, and the mortality after herniotomy for this condition is very high.

Vaginal hernia.

An unusual form of hernia may be mentioned, requiring a truss of a different kind, namely, the protrusion into the vagina, of the *walls of the vesico-vaginal pouch.* In this hernia there is generally no definite sac; it occurs in childhood, and tends generally to get well of itself, but if support be required it must be given as in *prolapsus ani*, by a pad in the vagina, attached behind to a perineal strap fastened to the middle of a belt, and ending in two straps in front, which pass along the folds of the groins on either side, to opposite the iliac spines.*

Measurements for trusses.

The only *measurements* necessary for the common kinds of inguinal, femoral and umbilical herniæ, are the circumference of the abdomen at the umbilicus for the latter, and of the pelvis just below the iliac crest and over the pubic symphysis, for the two former.

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* This condition is described and drawn in Holmes's "Diseases of Children," p. 560.

For partially descended testis.

When an *undescended testis* has never entered the inguinal canal at all, nothing requires to be done, but when, as often happens, it lies in the course of the canal, it will there be very liable to injury and consequent inflammation, unless some hollowed pad be placed over it for its protection. This, though not a truss proper, is fashioned like one, and will have to be specially made.

In adult cases the testis usually remains within the abdominal cavity, but sometimes becomes engaged in the internal ring, giving rise to pain, or to the more acute symptoms of strangulation. In these cases it is generally advisable to treat this descent of the testis as an ordinary inguinal hernia, and to keep it up with a truss out of harm's way, but it will be wise to remove the organ if the irritation persists.

Hernia of the ovary.

In the female, too, *hernia of the ovary*, into the neighbourhood of one of the labia, not uncommon in childhood, requires a light inguinal truss, which almost invariably effects a cure.

Rare herniæ.

The rarer kinds of hernia, such as the *obturator*, the *ventral*, the *lumbar*, etc., can not usefully be considered fully here. They will generally be treated by trusses or belts of special form, but made on the same principles as those for more common ruptures. The first two kinds are well known, but are rare; the third, the *Lumbar* hernia, or protrusion of abdominal contents through the loins, is very rare; the best description to be found is by J. Hutchinson, junr.,* to which the reader is referred. In all probability a belt is the right treatment in these cases, although Mr. Owen records a case of radical cure by operation.†

It may finally be mentioned that in cases of spinal bifida, or meningocele, which are indeed herniæ, some form of truss, or of support and compress combined, is sometimes indicated.

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* "Brit. Med. Journal," July 13th, 1889.

† "Brit. Med. Journal," May 5th, 1888.

CHAPTER IX.

OF THE USE OF ADHESIVE STRAPPING.

Adhesive strapping.

THE use of this material in surgical dressing, for the purposes of mechanical support, is steadily increasing, and the number of medicated plasters is being almost daily added to. Of these latter very little need be said, for with few exceptions, their value is still undecided. One or two however are certainly of great service in appropriate cases.

On linen.

The ordinary *adhesive strapping*, diachylon or lead plaster (*emplastrum plumbi*) is the form which is still in most general use, and unless otherwise mentioned, must be understood to be the material employed. It is sometimes spread on paper, when it is almost useless, but is generally laid on linens of varying fineness, or upon leather. No good purpose is served by using a fine linen, and the best strapping for all ordinary occasions is what is known as "Leslie's Hospital quality," sold in rolls eight inches wide.

On leather.

Other kinds of plaster are often spread upon chamois leather, or on white basil, and, as will be mentioned directly, leather should generally be employed when pressure is required, as in strapping an inflamed joint, by reason of its stretching powers.

Rubber strapping.

Recently, a very useful form of strapping, the basis of which is indiarubber, has been introduced, namely, Seabury and Johnson's *rubber adhesive plaster*. Its advantage is that no heating is required, the adhesive surface being protected by a layer of coarse muslin until it is used.

Isinglass plaster.

Another very good kind, for small surfaces, is the *isinglass* plaster, made by painting thin silk with that material. It requires wetting only, and is very cleanly.

For clean cut wounds about the face, etc., and in other cases where great nicety is required, court plaster or goldbeater's skin (a thin film of collodion) is generally used.

Danger of circular strips of strapping.

No detailed description is required of the ways in which strapping may be cut into strips, and used to fasten splints or dressings. But the warning given so eloquently by Sir James Paget* may well be borne in mind whenever this rigid material is being used. Such a disaster, as he in his lecture describes (a fatal case of acute cellulitis following the application of a circular piece of strapping), can hardly occur if the plaster be spread on any kind of leather; but this, from economical reasons, will often not be the case, and it may be taken as a rule to be followed almost invariably that strapping should be put on either spirally, or obliquely so as to form the half of an 8.

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* "Clinical Lectures," p. 60. The Calamities of Surgery.

If strapping is to be applied round a limb, it should be cut in strips and put on so as to secure an even, steady pull from both ends, otherwise the skin may be painfully wrinkled. It should always be thoroughly warmed first, for which purpose cylindrical hot water tins are generally used, or some gas apparatus. Sometimes strapping is softened by dipping it for a moment in very hot water; this makes it more pliable, and not much less adhesive.

For accurat adjustment.

When the strapping is required to accurately adjust or support the edges of wounds, of amputation flaps or the like, the strips should never be stuck first on one side and then pulled over to the other, or "cockling" will certainly occur, but should be cut in pairs, and applied as in Fig. 79, or on some similar plan. One strip is placed on one side of the wound and the other on the other; the middle parts are slipped the one within the other, and then an even regular pull can be made simultaneously on both sides.

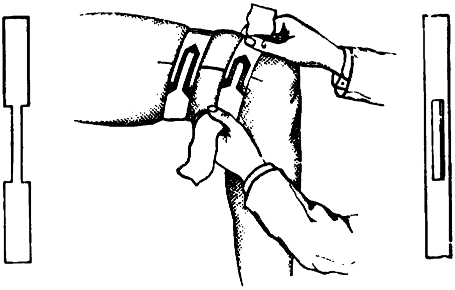

FIG. 79.—*Strapping applied to close a Wound accurately.*

Of some special uses of strapping.

Some special cases in which strapping is a common plan of treatment will here be shortly described.

Chest.

The case of fractured ribs will be afterwards again referred to. Not only in fracture, but where the thoracic walls have been badly bruised it is often desirable to place them as completely at rest as possible. This may be done very effectually by strapping them as if they had actually been broken. (See *broken ribs.*)

Fingers. *Enlarged phalangeal joints* may often be strapped with common plaster or with the iodine strapping to be hereafter mentioned. The method of doing this is the same as for the larger joints, and does not require a separate description.

Wrist. *The wrist,* either for a simple sprain or for the common teno-synovitis of the extensors of the thumb lying over it, may be strapped with strips of linen or leather plaster applied in the same manner as for the knee, Fig. 80; or a single piece of chamois leather may be used in the way which is described below.

Knee. Every dresser should know how to *strap the knee joint* efficiently, for it is one of the principal methods for the treatment of chronic derangement of this articulation. The usual plan is to apply strips of the plaster, overlapping each other, from below upwards, in half loops of 8, until the whole joint is covered. This may be done well with the plaster spread on linen or holland if great care be exercised. but it is better to use leather, on account of its superior elasticity.

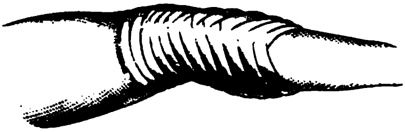

FIG. 80.—*Knee, Strapped* (*ordinary way*).

A better way of strapping this joint in the less acute forms of its disease, is one which is little known, and so may here be described in detail.

If the plaster be spread on chamois leather it will be found quite easy to firmly envelop the whole joint with one piece, provided the adhesive material be well spread and well warmed. The piece should be oblong, and large enough to go round the knee and overlap about one inch, and should be from ten to fourteen inches long. After warming it well, the centre of the leather must be very evenly applied to the skin in the popliteal space; one-half of it must then be drawn over the inside and front of the knee, with force enough to produce the pressure required; this will be found to stretch the leather sufficiently to bring it well over the front. The other half is then brought quickly and firmly over the other side. If the leather has been properly warmed, it will stretch so as to overlap for nearly three inches, and the plaster will be applied so closely to the skin that it will follow every wrinkle in it when the knee is flexed, and yet a firm, even compression will be attained. (Fig. 81.)

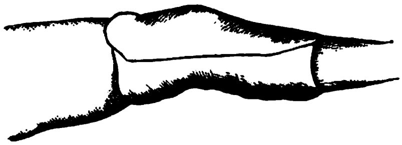

FIG. 81.—*Knee, strapped with one piece of Chamois Leather.*

Ankle. *The ankle*, similarly, may be strapped either by narrow strips of linen or leather, or by one broad piece of chamois, the middle of which is applied to the sole of the foot, and the two ends brought up and crossed in a figure of 8 over the front of the foot, and round the malleoli.

Breast. Long strips of adhesive, or diachylon strapping, may be usefully employed to support, and to a moderate extent, to compress *an enlarged or inflamed breast*. The centre of the strips must be placed below and the ends crossed above, working from below upwards, the breast being thus supported by the overlapping plaster. But, as a general rule, this kind of support can be more easily and comfortably maintained by the use of "Martin's" rubber bandage.

Testis. To efficiently strap *an enlarged testis* is difficult, unless the organ be very large. The art, however, must be acquired, as the compression thus produced is a most valuable method of treatment in cases of inflammatory exudation. The look of a properly-strapped testis may be gathered from Fig. 82, but it is always difficult to make a neat job of it. Leather should be used if possible. First of all, the parts having been shaved, the testis must be fixed down into the scrotum by a long strip passed round and round its upper part. The body of the gland may then be compressed by overlapping strips put on circularly, that is, horizontally, from below upwards, or vertically, to produce the same appearance as in the recurrent bandage for a stump, or with a combination of these two ways. In truth nobody ever straps two testes in the same way, or obeys any fixed rules, so long as the compression is attained. Another good way of applying even compression to an enlarged testis is to envelop the gland in a layer of cotton wool, and then to stretch over this a square piece of thin indiarubber sheeting (the best is that used by dentists, but that similar to Martin's bandage material will do), securing it at the top by slipping on an indiarubber ring.

Medicated plasters. It has hitherto been assumed that the strapping has been employed simply for the purpose of mechanical support, or of compression. But frequently the adhesive material possesses in itself (or is applied over ointment possessing) medicinal properties. As examples of these special plasters the *Emplastrum belladonnæ* and *E. opii* are frequently used for their anodyne properties; the *E. hydrargyri* or *hydrarg.* c. *ammoniaco* and *E. potassii iodidi* for promoting absorption.

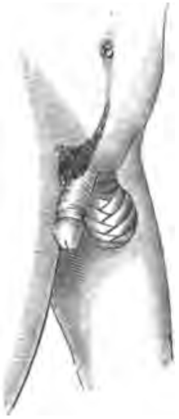

FIG. 82.—*Enlarged Testicle—strapped.*

As stimulants, the *E. galbani* or *E. picis* (poor man's plaster) are supposed to have merits, as to which we may be allowed to be a little sceptical, while the use of the milder cantharides plaster, *E. calefaciens*, explains itself.

Lastly, in addition to the soap and lead preparation, the *emplastrum ferri* (E. roborans) has great adhesive power, and is often applied to the lumbar region, with the idea of strengthening the muscles of the back.

Of the anodyne preparations, the *belladonna plaster* is most frequently used for the purpose of allaying pain in the breast, and for arresting the lacteal secretion, but it is a good anodyne for general use.

For strapping joints, etc., the E. hydrarg. c. ammoniaco will be found on the whole to be the most useful.

An extremely useful strapping is the iodine plaster, prepared by Ewen, of Jermyn Street.*

Strapping over ointment spread on lint.

One of the most effective modes of treatment of enlarged joints, inflammatory bursal enlargements, chronic orchitis, etc., is to cover strips of lint with some absorptive ointment, to lay them over the part and then strap it up firmly with soap or lead plaster. The ointments most commonly used are the various mercurial ones, all the *iodine*, *iodide of lead*, and *iodide of potassium* preparations, but especially the *camphorated mercurial ointment*, the well known *Scott's dressing.*† The strapping, with the ointment beneath it, should be left on until the latter is absorbed, or until the parts below have shrunk so as to make it loose; it may then be re-applied if necessary.‡

Scott's dressing.

To remove strapping.

When strapping has been applied to any part of the skin which is hairy, its removal is always painful, sometimes very much so, unless the adhesive material be softened. This may be done with very hot water, but a better way is to soak a pledget of lint in spirits of turpentine, and to soften and dissolve the plaster from the hairs, as the strapping is turned gradually back.

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* This, when spread on chamois leather, and applied in the way already described, forms the most satisfactory strapping for enlarged joints which we have yet met with. It should be freshly prepared or kept in a tin case.

† So called from the name of the surgeon who introduced it. *Vide* "Scott on the treatment of Diseases of the Joints, etc." London, 1857.

‡ The subject of blistering plasters, fluids, etc., will be discussed later.

CHAPTER X.

OF SPLINTS—CONSIDERED GENERALLY.

Of splints.

DEFINITION. A splint is *a contrivance or apparatus possessing absolute or relative rigidity, which when attached to some part of the body increases its natural stiffness, or remedies undue mobility caused by disease or injury.*

It will be seen therefore that the subject of the application of splints is a very wide one, and even a simple list of the various arrangements devised by surgeons from time to time, to fulfil the requirements of disease or injury, would be a catalogue as long as it would be useless and wearisome. We propose in the first place to give only a general description of the principal methods of splinting, and of the common forms of splints, postponing a more exact account of many of them until the various fractures and injuries which require their employment come to be discussed.

Natural splints.

In many parts of the body, an uninjured bone in the neighbourhood of one that is broken, will often serve to keep the fragments of the latter in their place, and in other parts the attachment of ligaments, etc., will serve the same purpose. Thus, in fractures of the fibula, the tibia, if unbroken, will make a very efficient splint for it. The same may be said of the ribs, where the muscles and ligaments, which form, with them, the cage of the thorax, very often prevent serious displacement.

A fractured lower jaw, again, may often be kept in good position by keeping the fragments close against the upper jaw, and many other instances might be adduced.

Improvised splints.

There is hardly a limit to the number of the materials which may be pressed into the service of the surgeon, to form splints in the first instance, in cases of fracture or of some other injury.

The usefulness of cardboard, book-covers, newspapers, firewood, and many other things familiar in daily life, will be mentioned in this connection under the heading of "Immediate treatment of Fractures." But the list is only limited by the ingenuity of the surgeon concerned.

It will be convenient here to give a short classification of the splints and splint materials which are recognised as belonging to the surgical armament.

Surgical splints—their different kinds.

Surgical splints may be divided into those of some fixed form and shape, and of some rigid material, as wood or iron, to which the trunk or limbs may be attached by bandages or strapping; and those which are capable of being moulded to injured or diseased parts, to give them the needful support or to remedy deformity. All of these latter possess the property of being soft when applied, and then of setting or hardening.

Rigid splints.

These are for the most part of wood or iron, though other materials, such as vulcanite, etc., are sometimes used. They may be sub-divided into those of a simple, and of a complicated form.

Simple wooden splints.

Plain *wooden splints* are the simplest of all, and will need little description. In most cases they are simply pieces of white pine, of various lengths and breadths, planed, and with their edges rounded off. They are used for fractures of the limbs, or to prevent flexion of joints, as in the common "patella splint," etc. Not infrequently they are made of strips of wood lined with canvas, on the plan of the kettle-holder splinting, to be presently mentioned, and other materials such as rattan, cane, etc., have been used from time to time. The pistol-shaped splint is again an example of a simple wooden splint, the use of which will be explained, with other forms, in considering Colles' fracture, and similarly, the use of Cline's, or of Liston's splints will be described in relation to the conditions they are devised to remedy.

Angular splints.

Angular splints (Figs. 83, 84) with or without a hinge at the elbow, are very useful in various injuries of the arm, and, like other forms of wooden apparatus (*e.g.*, the

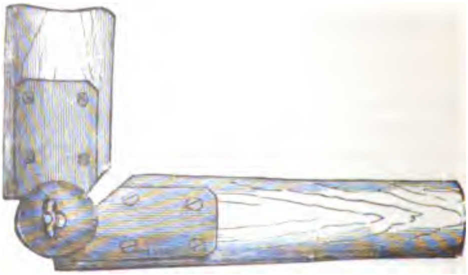


FIG. 83.—*Wooden Angular Splint with Hinge.*

back splint for the knee), are far more comfortable if they are somewhat hollowed out, a proceeding which adds but little to their expense.

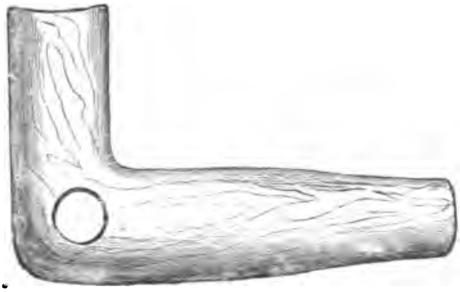
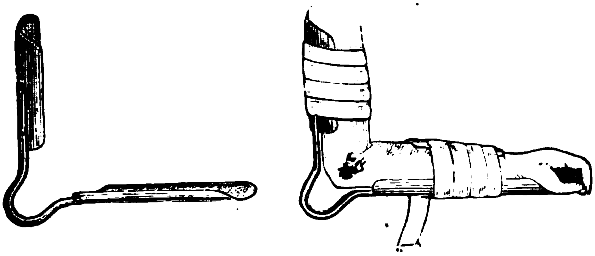


FIG. 84.—*Simple Angular Splint.*

Figs. 85, 86, illustrate an angular metal elbow splint invented by Mr. Thomas Jones of Manchester, especially for compound injuries of that articulation; it is described in the *Lancet*, vol. i, 1885, p. 1125, and is very simple, effective, and cheap.



FIGS. 85, 86.—*Angular metal Elbow Splint.*

Complex wooden splints.

Of the more complicated splints, in which wood is the principal material employed, the chief are "Bryant's" for excision of the hip, fracture of the thigh, etc., "Gant's" for the treatment of genu valgum, splints for fractured patella, and the double inclined plane; these, and others, will be noticed in their places.

Interrupted splints.

It is often necessary, in cases of compound fracture, or after excision of joints, etc., where we must be able to get at a wound which therefore must not be covered by the splint, to make *an interruption*, as it is termed, and although this is done in iron (Fig. 92) as well as in wooden splints, it is far more easy in the latter, as in Fig. 87. In making such a splint it is best to choose one as if the necessity for the interruption did not exist, and then to saw away the parts required to be removed, *after* having fastened on the iron supports.

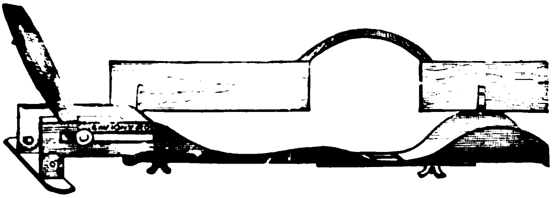


FIG. 87.—*Iron Back Splint, with "Interrupted" Wooden Side Splint.*

Iron splints. *Iron Splints* may be simple or complicated; as examples may be mentioned the common angular elbow splint (Fig. 88), generally having a hinge at the elbow; the simple back splint for the leg and thigh, with a foot piece, commonly used for fractures of the leg, generally called "Neville's splint;" and the different patterns of that very useful splint, "MacIntyre's" or "Liston's" (Fig 89), which consists of a movable foot piece, and leg and thigh pieces, with a joint between them, and with some mechanical arrangement of screws or rack and pinion, to alter the angle at the knee. These can be adjusted for limbs of different lengths by means of the movable foot-piece

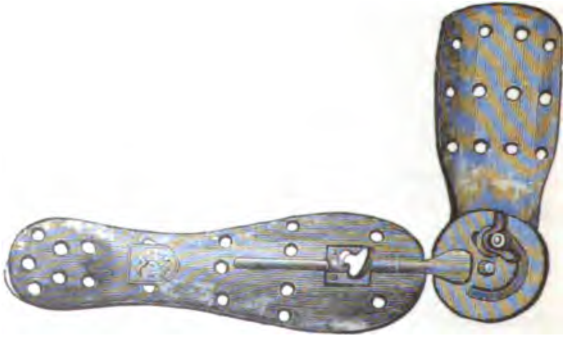


FIG. 88.—*Iron Angular Splints, with arrangements for Pronation and Supination.*

All leg splints for fractures should be furnished with cross pieces, to enable the limb to be swung from a cradle, as shown in Fig. 126.

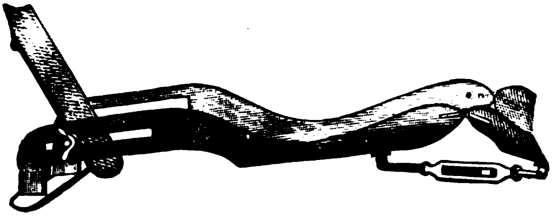


FIG. 89.—*MacIntyre's Splint.*

There are numerous patterns of splints used after excision of the wrist, elbow, and knee, of which examples are given in Figs. 87, 88, and 91.

Flexible splints.

Splints are also made of tin or some other flexible metal which can be readily bent into any required shape. These are often used in the treatment of talipes *(q.v.)*.

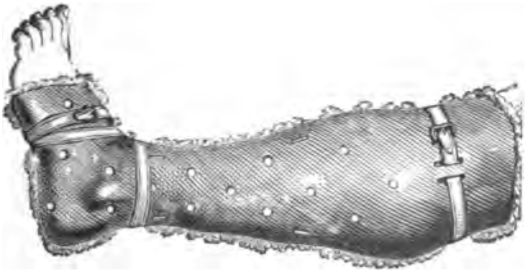


FIG. 90.—*Dr. Guillery's Flexible Splint.*

Fig. 90 is a drawing of a German flexible splint which is sometimes used in this country. The splints are made of different sizes for the arm, forearm, thigh, and leg, and are accurately blocked to the contour of each limb, and retain them in good position in cases of fracture after the displacement has been reduced. They can readily be blocked up differently if any abnormality in the shape of the limb be present. The splint can be procured at most instrument makers. They are named after their inventor, Dr. Guillery.

Woven wire splints are also still used in cases of fracture, but not so commonly as heretofore. They are at once light and strong.

Gooche's splinting. "*Kettle-holder*" or "*Gooche's Splinting*" is made by attaching long thin strips of wood to canvas or leather with strong glue. It is made in large sheets, and splints of different patterns can be cut or sawn out of it. Its great merit lies in the fact that it is flexible in one direction and rigid in the other. It is especially used for fashioning splints to partially encircle a limb, as in fractures of the arm, or in combination with a back splint in broken thighs.

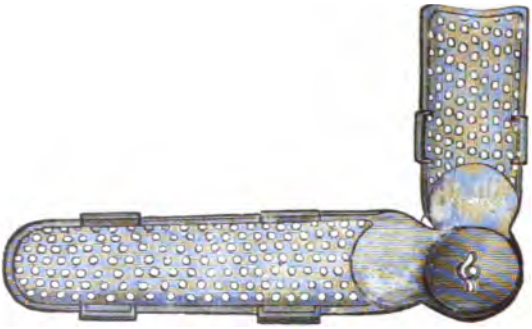


FIG. 91.—*Perforated Metal Angular Splint.*

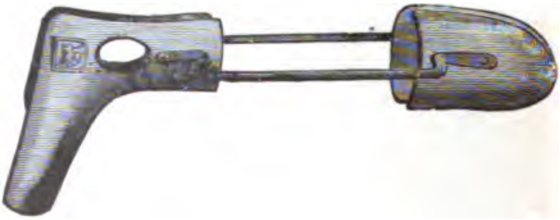


FIG. 92.—*Clines' Metal Splint, interrupted.*

Padding splints. To avoid repetition, a few general directions may here be given as to the ways of padding splints and attaching them, but they can only be of the most general kind.

All splints, before they are applied, should be padded, to avoid injury of the softer parts. This may be done in several ways, and with different materials. Of all paddings, however, the most elastic and convenient is tow, well teased, so that the fibres lie all one way, and with no lumps in it. Soft linen, such as old napkins, etc., makes the best covering for the tow.

For the simple forms of splints, the pads should be made like miniature pillows, and either sewn on with a lace stitch at the back, which is best, or fastened—but as a makeshift only, with bands of strapping very smoothly applied (Fig. 93). Pads should always be complete cushions, not layers of tow laid upon the splint and covered.

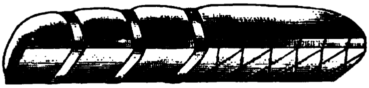


FIG. 93.—*Pad, sewn or strapped upon a Splint.*

Next to tow as a stuffing comes cocoanut fibre, and last of all cotton wool, which is very apt to work into hard lumps. Very good but extravagant pads may be made of several folds of lint.

Covering with oil-silk, etc.

In all cases where moist or oily dressings, or the discharge from wounds, can possibly soil the pads, they should be covered with some form of oiled silk or with gutta-percha tissue. The former must be sewn on, but the best and neatest way of fastening the latter is to moisten the edges with a piece of lint dipped in chloroform, when they will readily adhere.

Iron splints are usually perforated for the sewing on of the pads, but if not they must be managed like the wooden ones. Before padding them it should be seen that the metal is not exposed by the wearing off of the lacquer, or the cover will be iron-moulded.

Importance of smoothness.

In jointed splints the pads should be made separately for each part, and especial pains must be taken to have them very smooth and of the proper thickness where they have to protect prominences of bone, such as the trochanters or malleoli. This is particularly true of the heel, under which the pad should be firm and rather thin, while the tendo Achillis immediately above it should be well supported with a thicker pad. A "sore heel" is a surgical disgrace to the dresser of a fractured leg or thigh.

Too much pains cannot be taken to select perfectly fitting splints and such as are in good condition. They should, in almost all cases be a little wider than the limb for which they are chosen; if this be attended to, partial strangulation, through their being put on too tight, is almost impossible.

Attachment of splints.

With regard to the various methods of attachment of splints, we need only mention here, that strapping, bandages, and buckled straps of webbing or leather are the chief agents employed; any one or all combined may be found most suitable, in each particular case. In bandaging the same rules apply as have been already given, but whatever way of attachment is selected, it should if possible be so managed that the limb can be examined from time to time without disturbing the whole apparatus, and in the case of the extremities, the fingers or toes should be easily got at, in order that the condition of the circulation may be noted. Lastly, complaints of pain or even of discomfort, in parts which are covered by splints, should never be neglected or thought lightly of.

SPLINTS FASHIONED OUT OF PLASTIC MATERIALS.

Moulded splints. These splints fall naturally into two divisions; in the first are placed all those which are fashioned accurately to the part, out of a mass or a sheet of a material which can be moulded when softened (generally by heat), and which is then allowed to set. The second division comprises those made by enveloping the part to be splinted with pieces of flannel or other suitable material of the desired shape, or with rollers saturated with a material, liquid at the time of application, but which afterwards hardens.

Division 1. In this division are included splints moulded from *leather*, *felt*, *gutta-percha*, *cardboard*, etc., the skilful fashioning of which is an important branch of mechanical surgery.

Leather splints. Far too often money is thrown away with very unsatisfactory results, through the mistaken notion that the making of these splints is either below the surgeon's or dresser's dignity, or above his mechanical powers. There can be no doubt, a leather splint for such a case as a chronic enlargement of the knee, or a fractured patella, will be more efficient, if made by one who understands the surgical necessities of the case, than by an instrument maker who must, from the nature of his trade, proceed in a beaten track, and according to a fixed pattern. Something of finish and appearance will no doubt be sacrificed, but the one splint will do its work, the other, very often indeed, will not. With a little care a dresser may easily turn out a very good looking leather splint, without giving any inordinate time or trouble to it. The best leather for the purpose is ordinary sole leather, of medium thickness, arm splints requiring a lighter kind than those for the leg. In all cases the leather should be carefully examined for flaws. The piece being chosen, it must, before softening, be cut out to the required pattern with a very sharp knife, Patterns for the chief kinds of moulded splints are given in Fig. 94, but in all cases the shape should first be cut out in paper and fitted as nearly as possible to the limb. The figure should then be marked out on the leather before cutting. **Patterns for.**

Splints may be made of leather for the ankle, knee, hip, spine, shoulder, elbow, wrist, and jaw. The question of spinal splints will be considered in a separate chapter, and inasmuch as among the rest, those for the elbow and knee are by far the most common, and as many of the directions for making them will hold good for splints fashioned out of the other plastic materials, these two will be described in detail.

Leather splint for knee. The back splint for the knee is a splint which is often required for the treatment of fractured patella in the later stages of union, or for chronic disease of that joint, or after its excision has been performed. The pattern should first be cut in paper (of the shape shown in Fig. 94, No. 5), of such a length as firmly to grasp the leg and thigh, and of a width such as will allow an interval of about half an inch between the two sides of the splint in front. The paper pattern must be carefully fitted to the part, and the leather then cut out from it. This must then be thoroughly softened in a bucket of cold water, which will take from twenty-four to forty-eight hours; if it should be desirable to shorten this time, a tumblerful of vinegar or of dilute acetic acid may be added to the water, when three or four hours will be enough to soften the leather. The splint should then be applied to the limb which has previously been covered with a flannel bandage, or what is far better, to a plaster cast of the limb, and bandaged firmly, while it is at the same time moulded to fit the curves with all the exactness possible. Too much care cannot be exercised in this, the most important stage of the work. When it is done, the leather must be allowed to "set" on the limb, a process which will take some hours, when it may be carefully taken off and allowed to dry thoroughly. It is then fit to be trimmed and finished by cutting away whatever leather is redundant, or where the edges seem as if they might chafe. The edges too must be bevelled on the inside with a very sharp knife. If it is considered advisable further to strengthen the splint with an iron backing, this may now be riveted on by a smith.

The lining is best done with chamois leather; it must be cut out from the same shape as the splint, but large enough

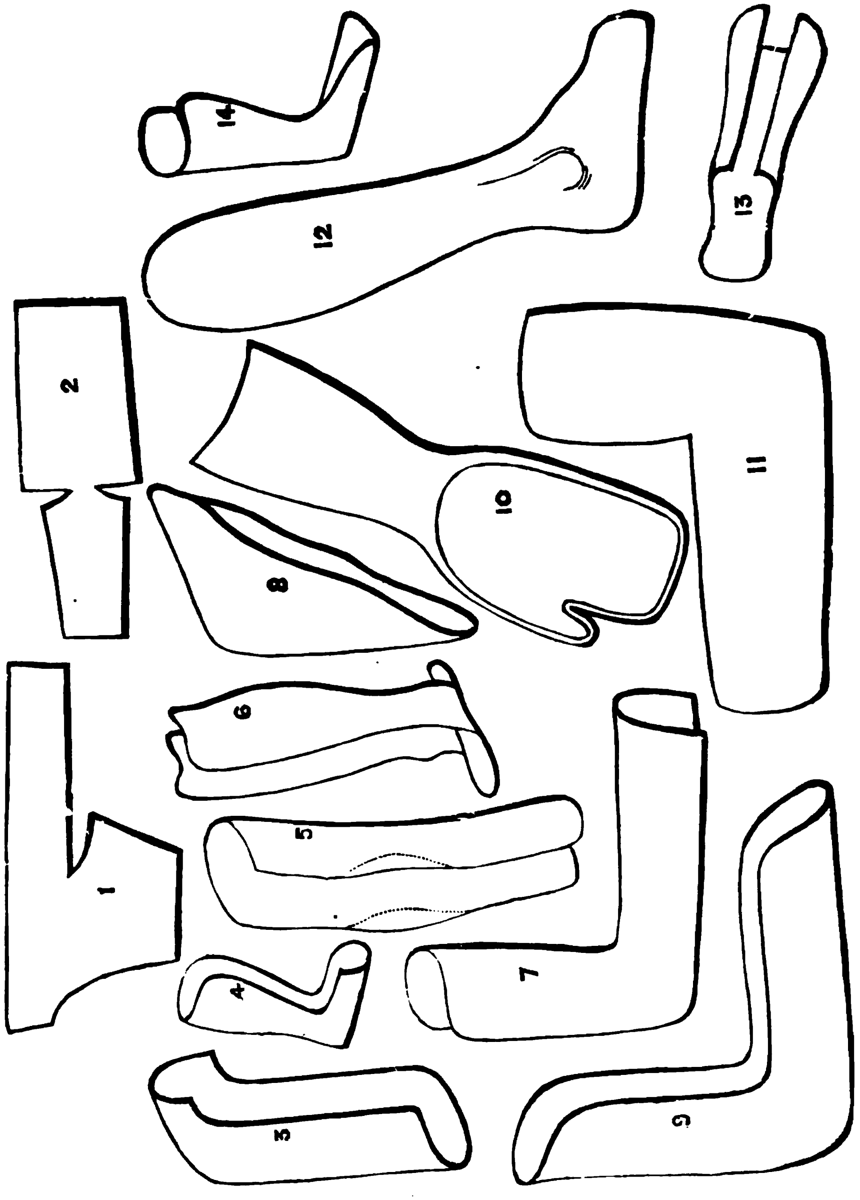


Fig. 94.—*Patterns for the principal forms of Moulded Splints.*

to overlap it everywhere for about half an inch. The inside of the splint is now brushed over with very hot thin glue, and the chamois leather stuck on. It will adhere very firmly; and the edges must be turned over and similarly fastened down, and then trimmed to an even width.

The finishing touch is given by punching the necessary holes for lacing and inserting the brass rings with the proper boot-maker's tool. If it be desired to polish the leather outside, this may easily be done with beeswax and oil melted together, and rubbed in while warm with a flannel.

In Fig. 95 is shown an ordinary knee splint, finished and applied.

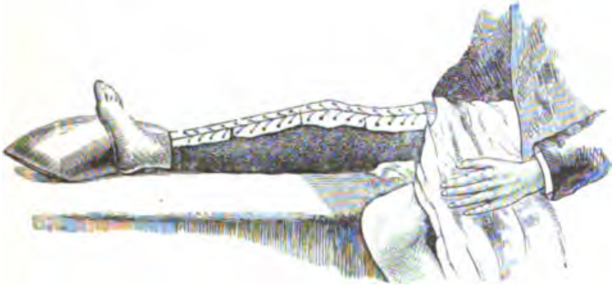


FIG. 95.—*Moulded Back Splint for the Knee, in leather or felt.*

Elbow splint

There are two principal ways of moulding an angular splint to the elbow, both about equally efficient. The pattern for the first is as in Fig. 94, No. 2,* the arm piece cut long enough to reach to the axillary fold, and that for the forearm, to the wrist. The leather is softened as before, and then, by bending the arm piece up at right angles to that for the forearm, they will overlap each other at the elbow, the arm ones going outside. The splint thus bent, is moulded by bandaging it on in the same way as for the knee, and may be trimmed, lined, and finished, as has just been described. The pieces at the elbow are fastened together by a few stitches of whipcord, or by passing through and bending over, some of the common clips used to fasten papers. This splint, it will be seen, is made of one piece, and may be laced along the middle line in front, or fastened there by two or three webbing straps. It is shown finished in Fig. 96. In the other pattern, two pieces of the shape of No. 11, Fig. 94, are cut out, softened, and moulded to the outer and inner sides of the arm and forearm. They may, when finished, be simply fastened round the limb by webbing, or leather straps; or a neater way is to glue the two halves along the back to a broad piece of tape or soft leather, so as to make a hinge: they can then be laced together along the front. The advantage this splint has over the other is that it may be put on and off very readily, but it is more troublesome to make, and is not quite such a firm support.

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* In this pattern the portion for the forearm is drawn too small.

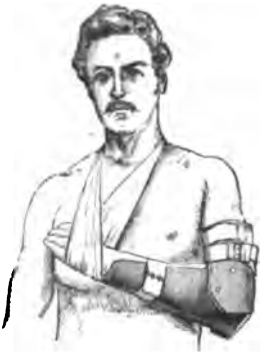

FIG. 96.

Blocking splints on casts.

It often happens that joints, suitable in other ways for leather splints, are too tender to bear the necessary manipulation of moulding. In this case, if it be decided to have one of this kind, a plaster cast must be taken of the limb, and the leather moulded to that ("blocked" as it is termed), when much greater force can be applied.*

Poroplastic felt.

A material closely resembling leather in its mechanical properties, but more easily applied, is now to a great extent superseding it for moulded splints, both large and small. This is felt saturated with some resin, in such a way, that while it preserves its porosity, and is but slightly increased in weight, it is rendered quite plastic by heat, but becomes again extremely stiff when cold. The advantages it possesses over leather are its lightness and porosity. Its disadvantages are that it is not so strong, and is more liable to crack or break. The fact that it sets very quickly cuts both ways, being sometimes useful, sometimes embarrassing. This material is now well known under the name of *poroplastic felt.* It is sold in sheets of various thicknesses and qualities; of the latter the medium are the best.

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* This procedure will have to be adopted also in all complicated forms of splints where the leather has to be stretched much out of its original shape. The dresser will, however, in such cases be wise if he adopt some other material, such as poroplastic felt, or gutta-percha.

As with leather, the description of the use of this felt in spinal cases is given later. For other splints, the patterns in Fig. 94 are those in most common use; most of them may be had ready made, or they may be cut out of sheets of the material. The best way of softening is by means of a steam chamber, made for the purpose, but an oven will do very well if the felt be first thoroughly moistened, and for most cases, water, nearly boiling, will answer the purpose. If softened in this way, the felt must be laid flat and quickly pressed between the folds of a towel to remove the superfluous water, before it is applied to the limb.

The method of moulding is in all respects the same as for leather, save that in consequence of the extreme rapidity with which it sets, the manipulation has to be very quickly performed. These splints may be lined, and eyelet holes punched as in the leather, but care has to be taken not to break the edges. If required, portions of the splint may be left unstiffened, or the resin may be removed from such parts after moulding by soaking them in methylated spirit.

Gutta-percha.

Next in usefulness to poroplastic felt comes *gutta-percha sheeting*, which is even more readily moulded. It is not, however, porous, and is not so comfortable as felt or leather, while in durability it is far inferior to them; on the other hand it admits of much more complete softening, so that it can be moulded more easily to tender parts, or to parts of a complicated shape.

The sheeting, of about the thickness of sole leather, having been cut out, is softened in water as hot as can be borne by the hands and rapidly moulded to the part, which should first be moistened. If the water be of the proper heat, some care will be required to keep the sheet from losing its shape through undue softening; and if it be too hot this will certainly happen, while on the other hand, water merely "hot" (*e.g.*, 100° F.) will not render it sufficiently pliable. The splint will quickly set sufficiently to allow it to be removed without losing its shape, and it should then be plunged into quite cold water, which will give it greater rigidity than it would have if allowed to remain on continuously. It may then be trimmed, and if desirable, lined, and punched for lacing, as before. It will, however, generally be best simply to put it on the limb over a piece of soft lint, and to secure it with webbing straps and buckles, for the gutta-percha is rarely durable enough to make the former proceedings worth the trouble.

Cardboard.

In the absence of leather, felt, or gutta-percha, a fairly efficient moulded splint may be made from common *millboard* or *cardboard.* After having been cut out of very stout board to the required form it must be thoroughly softened in water, and the details of manipulation may be in all respects similar to those for plastic felt. In most cases, however, the best support will be obtained by cutting the millboard in strips, about 1½ inches wide, softening and then applying them to the limb, one or two at a time, while a roller is at the same time applied, so as to mould and fix them as well. In this way the strips come to be within the layers of the bandage, and give considerable rigidity to the limb. The splint thus applied has to remain on, and cannot be finished up like the preceding ones, and for this and other reasons the cardboard splints are now nearly superseded by the felt.

Other materials.

There remains to be mentioned one or two materials, occasionally, but more rarely used in general or special surgery, as, for example, *gutta-percha* in mass, *vulcanite*, and *gum resins.* All these are principally used in dental surgery, and their employment in cases of fractured jaw will be described under that head; but the student may be reminded that for splints of delicate construction, materials such as these may be used; so, too, metals, others than those already mentioned, may sometimes be found useful, *e.g.*, lead, silver, or aluminium, the last being specially valuable for its lightness, although its cost prevents its extensive employment.

Splints or bandages dressed with a stiffening material.

Division II. Moulded splints made of bandages, saturated with a plastic material. Whatever be the stiffening agent used, the principle is the same for all the splints described in this division, namely, that the part required to be supported must be covered with bandages, into the interstices of which there may be introduced some material which, soft at the time of application, becomes afterwards hard, so that the part is enclosed in an accurately fitting case.

The materials in common use for this purpose are *plaster of Paris, gum and chalk, silicate of potash, stearine* and *starch; glue* mixed with spirits of wine, to enable it to dry, has also been used. These will be described in the order just mentioned.

Plaster of Paris

Plaster of Paris is the best and the most commonly used material for most kinds of splints, for injured limbs, and also for one important variety of spinal support. It is a fine white powder, and is obtained from burning, and thus expelling the water of crystallisation from *gypsum*, a peculiar form of sulphate of lime. Its value depends upon its power of quickly reabsorbing this water and solidifying.

Its uses.

In surgery it is used (*a*,) as a means of stiffening roller bandages, as will be described below; (*b*,) as a means of giving a similar stiffness to pieces of coarse flannel, which, having been shaped and immersed in the plaster, are then moulded to the limb; (*c*,) for making casts on which splints of other material can be blocked, and for a variety of other purposes.

Whichever plan is adopted, bandage or shaped flannel, the skin must be protected from direct contact with the plaster; for example, if a plaster roller were required for the leg and foot.

Plaster bandages.

The part to be splinted should be first evenly covered with a soft flannel bandage, or some well fitting flannel clothing. The bandages, which should be about two-thirds the length of an ordinary roller, and 2½ inches wide, are made of a very coarse muslin, to which the name of *crinoline* is generally given.

They are prepared by rubbing the dry plaster in powder well into the meshes, and then rolling up loosely. When made they should be kept lying on their sides in a tin box till required.

To make the splint it is only necessary to put the bandages in water till all the plaster is well soaked, and then to roll them on the limb, allowing them to take their own course to a great extent, avoiding reverses, and not attempting to form any regular pattern. The more oblique the general direction of the bandage is, and the more figures of 8 are made, the better. Three layers of the bandage are generally enough to make a firm case.

In all cases where a stiff bandage is applied to the leg, great care must be taken to keep the foot at right angles. This is easily done by passing a clove hitch round the big toe with a long piece of bandage, which may be fastened to the head of the patient's bed, or round his neck. When the case has been applied, it must be kept quite still until it has set; this will require from half an hour to three hours, according to the weather, the dampness of the bandages, etc. The setting may be hastened by hot water bottles or proximity to a fire.

Sometimes it is desirable to retard the setting; this can be done by soaking the bandages in mucilage and water. When this plan is followed, some surgeons cut the saturated and moistened bandages into strips, which are laid down, over-lapping each other; the limb is then laid upon them and they are brought round it in order, and the ends crossed in front in a spiral fashion so as to produce the appearance of an 8 bandage (see Fig. 80). This mode will be alluded to again under the head of spinal jackets.

Bavarian splints.

Sometimes the plaster may be used as a mass moulded between two shaped bandages. This is, indeed, the original "Bavarian splint," a method now almost obsolete. These splints are usually made for cases of simple fracture of the leg, but are not confined to these injuries. Taking the leg as an example: two pieces of flannel or stout canvas are cut out to a pattern which can be accurately got by cutting open a stocking which would fit the patient, along the front of the leg and foot and then spreading it out; or more roughly, by making "a double" of No. 12 in Fig. 94. The pieces of flannel or canvas are then laid one on top of the other and stitched down the middle line. The limb being laid upon them, the piece next to the leg and foot is brought round these parts and fastened along the front with safety pins. The corners *only* of the outside piece are then brought up, and pinned or stitched to the corresponding corners of the inner one, so that there is a kind of bag open along the top, on each side of the leg and foot (Fig. 97).

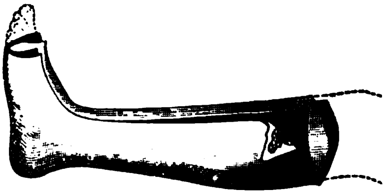

FIG. 97.—*Bavarian Splint* (*semi-diagrammatic*).

The plaster is then quickly mixed in a basin and stirred with the hand until it is of the consistence of thick cream. It is then poured into the bag on either side, the stitching along the back of the leg of course preventing the plaster from going right round. When enough has been poured in, it is pressed and moulded in all directions by the hands so as to make an even layer of plaster, about a quarter of an inch thick, between the flannel or canvas sides. A roller may then be put on to complete the moulding while the plaster sets, which will take from half an hour to an hour. The splint is then taken off by unpinning the inner layer of the bag in front; there will then be found a kind of hinge behind where the two layers were stitched together, enabling the sides to open. The case is now trimmed and lined, or simply put on over a flannel roller and secured with webbing straps.*

The plaster in this and all other cases must be very dry; it is, therefore, a wise precaution to have it put into an oven for an hour before it is wanted.

In all cases when plaster of Paris is used, while the bandage is being put on, a moderate amount of the plaster, moistened, should be rubbed into it, and the hands, well wetted, should be passed up and down to distribute the plaster evenly, and to rub it into the bandage thoroughly.

Silicate.

The *silicate case* is made with ordinary bandages and a saturated solution of silicate of soda, with or without the addition of a little chalk or whiting; it is applied in precisely the same way as the gum and chalk one so that one description will do for both. In their mechanical properties, also, the two cases are very similar. The silicate is slightly heavier, and perhaps not quite so durable; on the other hand it sets rather more quickly, taking from three to four hours, while the gum and chalk take from twelve to eighteen.

Gum and chalk.

Gum and chalk. We owe the first description of this form of encasing splints, we believe, to the late Mr. Smee, who brought it into use at St. Bartholomew's Hospital.

A sufficient quantity of dry powdered chalk, free from lumps, is mixed in a basin with mucilage, until it is of the consistence of gruel. The limb being first bandaged with flannel (and in the case of the leg or thigh, the foot fixed at right angles with the heel elevated on a block), is carefully bandaged with a common calico roller, the flannel roller extending beyond it for about half an inch. The mixture is then rubbed into the bandage with the hands, so as to permeate it thoroughly. Another bandage is then put on and treated in the same way, and generally a third will be found necessary. The case is then left to dry.

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* This form of splint is now almost abandoned in London in favour of those made of coarse flannel, soaked with plaster of Paris cream, after Mr. Croft's, or some similar method; these are described under the heading of treatment of fractures of the leg (*q.v.*).

The advantages of a well made gum and chalk case are many. It is lighter when dry than plaster of Paris, and though abundantly strong, has a certain flexibility which prevents it cracking. On the other hand it requires more time and patience in application, and the length of time it takes to set is sometimes inconvenient. It is, however, generally preferred by those who are accustomed to put it on.

Stearine or paraffin.

The stearine case suggested by Mr. Lawson Tait, is very clean and very rigid, but it is liable to crack. It is most suitable for limbs which require to be fixed upon splints for some length of time while the patients are confined to bed, or at least have not to move much. Thus it is a very good way of fixing the leg and thigh on to the splint in cases of resection of the knee. The paraffin is cut up into small chips and heated in a vessel placed in a saucepan full of boiling water, for the wax itself should not be heated above 212° F. Gauze bandages, similar to those used in antiseptic dressings, are then immersed in the melted wax. The paraffin takes about two minutes to thoroughly penetrate to the centre of the roller. The bandages must then be applied to the limb over a flannel bandage while they are as hot as the operator's hands can bear.

Starch.

Starch is the least efficient material for making a supporting case, but, on the other hand, it is one which is always ready to every one's hand.

It is applied like gum and chalk, by rubbing starch paste into the interstices of ordinary bandages. Four, or even five thicknesses will be required for any useful degree of support. The limb must be kept very still while the case is drying.

It may here be mentioned that a common roller bandage (*e.g.*, one used for securing fracture splints) has a more neat appearance, and is less liable to be disturbed if a little thin starch paste is brushed or rubbed over it after it has been put on.

Its chief drawback is the shrinkage which occurs as the splint dries on the limb, which is not present when other materials are used. This may even produce gangrene, and must prove a source of anxiety, necessitating careful observation of the circulation until the splint is dry.

Spicas.

Plaster of Paris, or gum and chalk spica bandages are very frequently used in early or convalescent cases of hip disease, or in fractures about the neck of the femur. They are applied like the ordinary spica, but require a rather firmer and longer hold on the thigh. That part of the bandage which goes round the pelvis does not require to be so much stiffened as the rest.

Trap-doors.

It is often necessary to apply a stiff bandage or case to some part where there is a wound. If the discharge from this be extremely small, it will be sufficient to cover it with dry lint; but if not, an opening or "trap-door" must be made. This is best done with a very sharp knife after the splint is firmly set, a careful note being taken at the time of application as to the exact position of the wound.

It will happen, every now and again, that through chafing, or some other cause, a sore develops underneath one of these splints. In such a case no time must be lost in cutting away the chafing part. This may be sufficient, but very often the whole splint will have to be removed, and the sore allowed to heal. It is, therefore, very evident that every care must be taken while applying the case to avoid creases or constrictions in the bandages, which may lead to such serious consequences. Another common act of carelessness which may lead to the above result is that of leaving pins within the folds of the bandage.

To remove plaster cases.

When plaster or gum and chalk cases have to be removed, a pair of strong cutting pliers (Scutin's) may be used, or an instrument devised by Mr. Davy, which is a combination of a knife and a saw, and which is very suitable for the purpose, if the splint is to be cut up along the middle line without other damage so that it may be used again. In other cases a strong jack knife will do, and on the other hand, if the limb be very tender it may be best to soak it and the splint in water until the plaster or chalk is sufficiently softened to allow of the layers of bandage being peeled off.

How to use plaster of Paris.

A few words as to the manner in which plaster of Paris should be practically handled, when used for the purposes of support, or any other surgical objects, may be useful.

It should be recollected that, except it is used on a very small scale, it is always a very messy thing to apply, and it is difficult to clean up afterwards. Clothes, carpets, and everything that is upholstered, should be protected or removed. Aprons, and sleeves (or bare arms) will be wanted also.

If the roller bandage is the method chosen, the dry plaster, in powder, must be distributed, as evenly as possible, on the unrolled bandages a short time before they are wanted. But they will keep a week if they are put in a tin in a dry place.

The best way to charge the bandages from end to end with the powder, is to pass them over a table or board with a heap of loose plaster upon it, and then to sprinkle them with it, rubbing it lightly into their meshes; passing them on from left to right, and rolling them up at the end of the table.

The manner of wetting the bandages has been already mentioned. It may be added that the vessel in which they are immersed must contain water at a depth sufficient to cover them. None must be put in water until everything else is ready. Then one only is to be thoroughly wetted through and the air expelled, and as it is taken out of the basin to be applied, an assistant puts another into the water. The times of application and of soaking will then coincide in a convenient fashion.

It will be seen that there is no regular rule given here for the amount of water to be taken up by the roller, and practically as much will be taken up by the powder as it lost as gypsum in the furnace, and no more.

But a little more accuracy and practice is required if the second way of applying the plaster is adopted, namely, by so adding the dry powder to the water that the mixture is a complete and creamy fluid, in which the pieces of coarse house flannel, already shaped as required, can be immersed and saturated with it, and still be flexible enough to be moulded to the limb before setting.

The best way is to take a quantity of water, in a basin or bucket, equal to about two-thirds of the quantity of plaster cream which is estimated to be wanted; then taking the powder, and gently and slowly scattering it on the surface of the water all over, let it sink by itself. This it will do very quickly at first, and then more slowly, until the plaster ceases to be dissolved but remains on the top of a cone of thoroughly moistened plaster in the water. The contents of the basin must now for the first time be stirred, and this is best done by the hand at the bottom, and quietly so that there are no surface bubbles; it will soon become uniformly thicker, and can be used at the thickness of rather thin cream. At the end of the setting it hardens very quickly. The cream for taking solid casts, as of the limbs or trunk, is used rather thinner than it is for stiffening flannel; that is, it is used as soon as it is mixed.

SECTION III.

OF FRACTURES.

CHAPTER XI.

OF THE IMMEDIATE TREATMENT OF FRACTURES, IMPROVISED SPLINTING, ETC.

General considerations.

IN this section, only such fractures as require manipulative surgical treatment will be considered, and only such of these as the dresser or house surgeon may reasonably expect to meet with, and which he must learn to treat, during his hospital experience. With regard to apparatus and manipulations, we shall describe chiefly those which are commonly used in London hospitals.

But before proceeding to the treatment of fractures individually, there are certain general points which must be understood.

The extent of injury.

The first time the student makes a post mortem examination on a recent case of fracture, however simple, even if there be to outward seeming only a very slight amount of injury, he cannot fail to be astonished at the extent to which the tissues have really suffered, at the amount of bruising and disorganisation of the muscles, and at the infiltration of all the softer parts with extravasated blood. And yet, provided that such a fracture be simple, or if compound, that septic forms of inflammation are successfully warded off, it is astonishing how quickly tissues, bruised and hurt as these are, will recover.

A further examination of a recent fracture on the post mortem table will show that the injury of the soft parts has been, to a large extent, due to the working of the sharp, splintered fragments among the more yielding tissues; indeed, in fractures by indirect violence, this is the only cause of their injury.

In considering then, the general line of conduct in cases of fracture, the student should think of the condition of the limb inside the skin, and appreciate that it is probably much worse than appears upon the surface; and further, he should recollect that between the time of the occurrence of the fracture and its being set, careless or improper handling may do much mischief, so that it not infrequently happens that by movements on the part of the patient or of his friends, a simple fracture is converted into a compound one; or, much more rarely, an important vessel or nerve is seriously injured.

It will therefore be seen that there are many points for consideration in the treatment of a case of fracture, in addition to the actual, and so to speak, permanent setting of the bones.

So long as the patient can be left lying, little further harm can come to the broken bones, so that there need be no hurry.

Chief points in immediate treatment.

The chief points in the immediate treatment of fractures are:—

1. The prevention of further injury (*a*) by means of some improvised support or splint, (*b*) by proper precautions in transport.

2. The arrangement of the bed on which the patient has to lie, probably for some weeks, the getting him into it, and the general management of affairs in the interval which must elapse before the setting.

I.—MEASURES FOR PREVENTION OF FURTHER INJURY.

Improvised splints.

Improvised Splinting.—This is desirable when there is any appreciable movement between the fragments, any painful spasm of the muscles, or whenever the patient has to be moved to any distance. The ways in which more or less efficient splints may be made are very numerous, so that in this matter the principles of the improvisation being indicated, the details must be left to the individual readiness and energy of the surgeon. Whatever comes first to hand will of course be used first, as firewood, match-boarding, cigar boxes, bookcovers, paper, etc., and it will hardly ever be found difficult to give sufficient support to any fracture. Even a newspaper will be of great service, if it be folded often enough, especially if it be bent round so as to form a portion of a hollow cylinder. In fractures of the leg, or thigh of one side, the use which may be made of the opposite sound one as a splint, by tying the two limbs together, should always be remembered.*

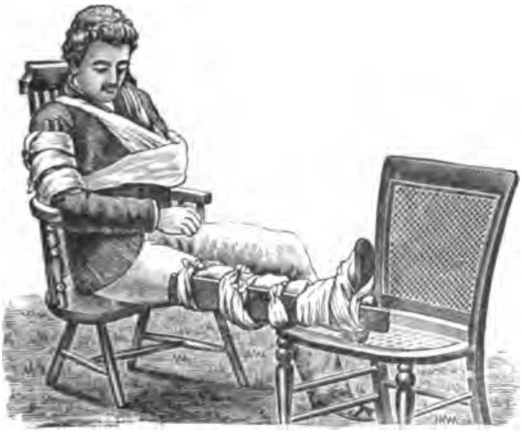

FIG. 98.—*Illustration of Improvised Splinting.*

Fig. 98 has been drawn to show a few of the ways in which common materials, such as firewood, towels, and handkerchiefs, may be used for the temporary support of fracture of the collar-bone, humerus, and of the bones of the leg.

As a rule *removal of clothes* is unwise until the patient is about to be put into bed, when it can be done deliberately, and so as to cause as little pain as possible, but if the fracture be badly compound, or if there be serious hæmorrhage, the clothing must be removed for more careful examination of the parts. These cases of hæmorrhage in connection with fracture are always serious, and the necessity of attending to this condition will take precedence of the question of supporting the broken bones. **Removal of clothes.**

Improvised splints should always be put on in a way which will allow of their ready removal, and in applying them there need be no effort made accurately to replace the fractured parts, but merely in a general and gentle fashion to reduce the deformity, and give support.

The following directions will serve as examples of what may be done in some of the more common accidents involving fracture of bones, in the way of a rough and ready splinting, it being understood that they are *examples* only.

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* The reader will understand that much of what is here written applies especially to fractures of the lower limbs, which generally stand in need of more active assistance.

Fracture of the lower jaw.

(1.) *Fractured lower jaw.* This will have occurred as a result of some direct violence, and there will be a good deal of bruising of the soft parts. All that will be required in the first instance will be to tie up the lower jaw against the upper one with a soft handkerchief, passed under the chin and over the vertex of the skull. The patient must not talk, and if any nourishment has to be taken it should be poured slowly into the mouth at one of the angles.

Of the collar-bone.

(2.) *Broken collar-bone.* This in adults may happen from direct violence, as by a bullet or any severe direct blow; in such a case the symptoms will be well marked. Or it may occur at birth or in young infants, by rough handling or slight drags or falls, in which case it may often be overlooked. But it is generally the result of an indirect shock, as by falling on the shoulder, or on the out-stretched hand. The patient instinctively supports the elbow and forearm of the injured side with the other arm, and so pushes up the shoulder, which would otherwise droop. If the patient can be conveniently put to bed on a hard mattress, flat on the back, with a small pillow between the shoulders, and a very small one (or none at all) under the head, the fragments of the clavicle will come absolutely into apposition. But often when this accident happens the sufferer has to travel for some distance, and although by merely slinging the arm all risk of any great additional damage will be avoided, a better plan is to use a couple of towels or triangular bandages in the way now to be described. With these the arm can easily be fixed in a position which will give complete comfort, and indeed, in many cases will bring the fragments into sufficiently good position to enable union to take place without any noticeable deformity. This method is also suitable for the permanent setting, and is mentioned later on under that head.

The indications to be fulfilled in cases of fractured clavicle are—that the shoulder must be well pushed up, the arm must be fastened to the side with the elbow behind a vertical line dropped from the point of the shoulder, and that the shoulder joint should be forced away from the thorax by a pad placed in the axilla, to counteract the tendency of the broken ends of the clavicle to overlap. A way in which this may readily be done is shown in Fig. 99 (and also in Fig. 98). A soft, but firm pad, of about the size of one's fist is made, as with a cricketing cap or a newspaper, and is placed in the axilla;* the forearm is crossed over the chest, with the hand pointing to the opposite shoulder, the point of the elbow being held well back. A towel is then folded as a broad scarf, the elbow is settled into the middle of it, and then, by tying the ends over the opposite shoulder, the hand and forearm being covered by the scarf, the arm on the injured side can be pushed well up. The other towel is then brought round so as to fasten the arm, forearm, and hand, firmly to the trunk, and the ends are knotted or pinned beneath the opposite armpit. A reference to the figure will explain better than words can do, these simple but efficient arrangements.

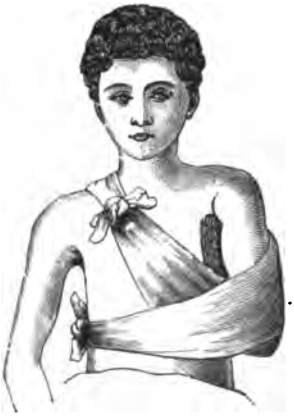

FIG. 99.—*Treatment of Fractured Clavicle with two towels, or Triangular Bandages.*

Method of settling with two towels.

(3.) *Fracture in the neighbourhood of the shoulder joint.* For this, inasmuch as the displacement and mobility of the fragments are both often either slight or obscure, a well-adjusted sling is all that is required at first, or during removal.

Fracture near the shoulder.

(4.) *Fracture of the shaft of the humerus.* Here the displacement may be considerable, and the ends of the broken bone, by moving on each other, may cause much pain and

Of the shaft of the humerus.

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* This direction is according to the orthodox teaching, but unless it seems to be obviously useful, it may be omitted.

muscular spasm. The weight of the forearm must be utilised to prevent overlapping of the fragments, and a little gentle traction may be made at the elbow. Some short pieces of firewood, cardboard, etc., should then be tied round the limb, outside the sleeve, with handkerchiefs, or something of the kind, care being taken that those on the inside are so short that the circulation is not impeded at the elbow (see Fig. 98). The hand and wrist should then be slung in a towel folded scarf ways.

About the elbow.

(5.) *Fractures about the elbow joint.* The forearm should be slung, but it will be unwise to attempt any reduction of the fracture, which is often complicated with dislocation, till arrangements have been made for its regular setting.

Of the forearm.

(6.) *Fracture of the bones of the forearm.* The limb should be supported by two splints, which need not be very rigid (brown paper folded several times will do very well), placed along the front and back of the hand and forearm, and reaching from the elbow to beyond the tips of the fingers. The hand should be placed midway between pronation and supination, with the thumb upwards; the splint on the flexor side must not embarrass the brachial artery when the arm is bent. The splints may be tied on with handkerchiefs, and the arm supported with a broad sling.

Colles' fracture.

(7.) *Colles' fracture at the wrist.* Impaction is almost always present in these cases, so there is no risk of undue mobility. A simple sling, therefore, is all that will generally be necessary, but sometimes, when there is painful spasm of the flexors of the fingers, relief is afforded by a soft splint along the front of the hand and forearm, lightly tied on. The fracture should always be set as soon as possible, in one of the ways to be described later.

Fractured ribs.

(8.) *Fractured ribs.* When an accident has happened, which in the nature of things may have caused one or more ribs to give way, and the injured person complains of a stabbing pain or "catch" in the breath, on inspiration, with other signs of embarrassment of the breathing movements, it will not be necessary in the first instance to distinguish whether there has been a bruising or an actual fracture of the thoracic walls. In the majority of cases it will be found that immediate relief is afforded by placing the hands on either side of the chest, and compressing the thoracic walls gently, but firmly. Very often the patient will have found this out, and may even have tied his scarf tightly round his body. Until a more complete support can be given to the thorax by strapping and bandaging, something in the way of a scarf or towel must be tied round the chest with the tightness which will give the greatest amount of relief.

A patient with broken ribs may thus be able to get home without much suffering, but he should be cautioned against any movement which would require any but the shallowest respiration, for though he may be comfortable enough so long as the diaphragm alone is concerned in the performance of breathing, his pain would be much aggravated by any effort which would bring the chest walls into play.

Fractured spine.

(9.) *Fractured Spine.* Whenever, or under whatever circumstances the back appears to be broken, no question of splinting can arise, but the harm, or rather the disaster, which may be wrought by rough or careless handling, cannot be too thoroughly realised.

The symptoms of fractured spine being present, the injured person should be placed in the supine, or prone position, on the ground, with the trunk as straight as it can be gently put. In the absence of a stretcher, a gate, hurdle, shutter, or some other rigid platform should be procured, and placed close to the patient, who must be placed on it with the least possible alteration of position. (For the methods of transportation, see page 151.)

Fractured pelvis.

(10.) *Fractured Pelvis.* This may occur from a fall, but in most cases the cause will be the passage of some crushing weight, as the wheels of a wagon. Little requires to be done in the first instance; but relief may be given by tying a broad scarf or belt round the pelvis, and the patient must be quickly placed on a stretcher or its substitute. It sometimes happens that even after a severe injury to the pelvis, the patient is able to walk after a fashion, but this must never be allowed.

Fracture of the neck of the femur.

(11.) *Fracture of the neck of the Thigh-bone*:—1. *Fracture in old people.* This will only require that the patient be moved with gentleness on a stretcher; no other precautions are necessary. 2. *Fracture with violence*, and injury to the softer parts around. This will usually be extra-capsular, and generally occurs in adults. In any case precautions must be taken to prevent further damage in removal; these, however, will be practically the same as are required in the following case.

Of its shaft.

(12.) *Fracture of the shaft of the Femur.* In consequence of the length and strength of this bone, its fracture may be attended with great disorganisation of the surrounding parts, and the injury is very easily made more serious still by rough or unskilful handling. In these cases the principal difficulty is that of transport, and the reader has only to imagine what might be the consequences of ill-advised efforts to move a heavy man with his thigh broken in the middle and unsupported, to see at once that no attempt should be made to move an adult thus injured till the limb has been rendered fairly stiff by improvised splinting. The end desired is practically to make the patient's body rigid from the armpit to the ankle, so as to prevent all risk of a bending or buckling up of the broken ends of the bone, which would otherwise readily occur. The patient should be kept lying absolutely flat on the back, and search should be made for something long and strong enough to serve as a "girder" to run the whole length of the body (a rifle or a broomstick will do admirably). This must then be laid along the injured side, the top going beneath the axilla, and the limb should be very gently straightened, since by this time it will probably have become much abducted, and rotated outwards. Then with numerous handkerchiefs, towels, etc., this long splint must be fastened on, passing the bandages round the thorax and pelvis. Along the inner side of the leg, a short splint, say an umbrella, should then be placed, and a back splint of thin board, or stiff paper folded, may be placed along the back of the thigh. These supports must then be fastened round the thigh, leg, and foot, as can best be managed. Finally, the injured limb must be tied to the sound one in two or three places.

If these proceedings have been thoroughly carried out, it should be possible, although it would be unwise, to carry the patient simply by the head and heels, without any bending.

Of the lower end of the femur.

(13.) *Fracture near the knee joint.* Here the risk of injury is very much less, and one of two plans may be adopted. If the limb be lying fairly straight, an inside and an outside splint, as two walking sticks, should be tied on with several handkerchiefs, avoiding the actual seat of fracture; or what will be found more comfortable, especially if the limb be bent, will be to place beneath the joint a thick pillow or other support, keeping it in the flexed position with a few bandages tied round all.

Of the patella.

(14.) *In a fractured Patella,* the great indication is to avoid increased separation of the fragments and further damage to the knee joint beneath. This will best be done by a strong back splint of umbrellas, boarding, etc., running behind the whole length of the thigh and leg, and tied on firmly with handkerchiefs.

Of the leg

(15.) *Fractures of one or both bones of the leg* generally occur from direct violence, and because the skin is so thin over the shin bone they are very apt to become secondarily compound, and may be so from the beginning. These fractures are thus often extremely severe injuries, and require much care and gentleness in handling. If the limb be very much crushed, with comminution of the bones, whether the fracture be compound or not, probably the best plan will be to take a soft pillow and arrange the stuffing so as to form a trough, lay the limb in it, and tie it up with soft bandages. In slighter cases, splints long enough to reach below the feet must be put on both the outer and inner sides, or on the outer one only. (See Fig. 98.) If the boot can be easily taken off, as by cutting up the side springs or laces, this should be done, but it should be left alone if it seems that removal could cause the slightest damage.

Pott's fracture

(16.) *In Pott's fracture with dislocation at the ankle joint*, it will be unwise to use any force to rectify the deformity, which will often be considerable. The boot should be cut off, and a splint, extending from the knee to below the foot, should be put on the inner or the outer side, as seems best, with handkerchiefs. The foot should be placed in as nearly a natural position as it will readily come to.

General crushing of foot or leg.

Finally, in those cases of *compound dislocation of the ankle*, or of a *general crush* of the parts about the foot, caused by great violence, little can be done, except to tie the parts up in a pillow, or to use such other materials for soft support as the circumstances of the case will admit of.

Transport.

Method of transport of cases of fracture, and precautions to be taken therein:—

In military surgery it naturally happens that great stress is laid upon the best ways of moving people, helpless from injury, whether through fracture or otherwise. A regular stretcher drill is laid down, and other plans for lifting and carrying are carefully considered.

But in civil practice, and in connection with the proper work of house surgeons and dressers, elaborate descriptions of the different kinds of stretchers and of kindred details would be out of place; still, it is desirable that all civilian dressers, surgeons, or porters, who have to do with helpless people, should have some acquaintance with the best ways of lifting and moving them, and one or two of these ways will here be mentioned, supposing always that the injured person is unable to walk at all. (The case of children need not here occupy our time.)

The sedan chair.

If two people only, A and B, are available for the transport, and the person is able to sit up a little, the best way to manage will be for them to make a "sedan chair" by crossing their arms. Of this "chair" there are three patterns, but one only is figured because it is the best for general use.

Varieties of.

In the first of the other two plans, the fingers of the right hand of A, and the left hand of B are interlocked to form a seat, while A's left hand is placed on B's shoulder, and *vice versa*, to make a back support.

In the second plan both A's and one of B's hands are joined to form a triangular seat, and B's other hand rests on A's shoulder, forming a chair back.

The best way.

But the third way (Fig. 100) is the best, where both pairs of hands are used, locked together to form a seat, and where the patient supports himself by his hands placed upon the bearers' shoulders.

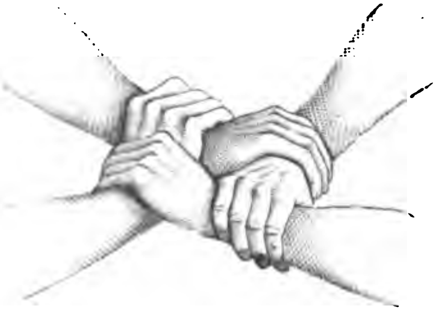

FIG. 100.—*Hands forming Sedan Chair.*

To lift a patient horizontally.

If the patient be quite helpless or senseless, whether he has to be carried any distance, or has only to be lifted on to a stretcher or bed, the assistance of three people is desirable, two, A and B to do the lifting, and the third, C, to look after the injured limb and the patient generally.

A and B take up a position on the opposite sides of the patient, near his haunch bones, facing each other; they then stoop down, and each gradually gets one hand under his back, near the shoulder blades, till they meet and are clasped; the other hands are then passed and locked under the breech.

Having secured a firm grasp they rise together from the stooping posture with the patient, and are ready to move.

It is not advisable for either to kneel, unless they cannot stoop low enough, but if one does, both must.

A patient lifted in this way can readily be placed on a bed, or be lowered on to a stretcher for more convenient carriage. In lifting a stretcher the taller of the bearers should go to the head, and should give the directions as to the time of lifting, etc. The head should always be lifted a little before, and lowered a little after the feet. In carrying anyone on a stretcher, the bearers should not keep step, but the left foot of the one must be put forward with the right of the other, to avoid swaying. It is not here considered necessary to give an account of the actual stretcher drill, where the bearers are numbered off, and have their several duties sharply defined, for the purposes of military discipline.

Conveyance in cabs.

With regard to conveyance in cabs, a four-wheeler is much better than a hansom. If the injury be very severe the patient should be lying down if possible, either from seat to seat, or if that space is insufficient, a stretcher may be laid across the floor of the cab, both doors being opened.

When a patient has been brought to the bedside, it will generally be found convenient to remove the boots and outer clothing as he lies on the stretcher, and then to lift him on to the bed as described above, when the removal of the clothes may be completed at leisure.

Of the diagnosis of fractures.

Diagnosis of fractures.

But few words need be said on this point beyond what is to be found in any surgical text book, to which the reader is referred for an enumeration of the classical and orthodox signs of fracture. They may, any or all of them, be absent, but the cases will be few in which a general knowledge of anatomy, guided by common sense, will not enable the surgeon to decide whether a bone is broken or not. Doubtful cases, however, do sometimes happen; on the one hand the fracture may cause so little displacement, and the other symptoms may be so slight that the condition is overlooked, while on the other, the injury to the vessels and soft parts and the swelling therefrom may be so great as to mask the condition of the bones.

In the first case no great harm will come of the failure to detect the break, and in the second the question will be cleared up when the swelling subsides; but in all cases of doubt there is only one rule to follow, namely, to treat the case in all respects as if a fracture were known to be present.

II.—OF FRACTURE BEDS.

Fracture beds. There are certain points to be looked to with regard to the bed on which a patient with a fractured limb will have to lie, and inasmuch as it is probable that once there, any further movement will be hurtful, they should be considered and met *before* the patient is placed on it.

The essential qualities which the bed should possess are, that there should nowhere be any "sagging" or possibility of giving way, that the surface should be evenly smooth and comfortably elastic, and that the foot of the mattress should be somewhat higher than the head.

Evils of ordinary bedsteads. In practice it will be found that very few bedsteads fulfil these requirements, even the best (the wire-woven beds, or those with interlaced iron bands), will allow of a certain giving way where the greatest weight of the body comes, while this occurs to a much greater extent in sacking, or sofa spring beds. The evils of this yielding and the formation of a hollow under the patient are not so apparent at first as they afterwards become; the patient gradually slips down, the head and shoulders are pushed forward, and the heels come up, until, instead of lying in a straight line, the body forms two sides of a triangle, the apex of which is at the ischial tuberosities, to the grievous alteration of the parts about the seat of fracture, and to the great risk of the formation of bed sores.

Fracture boards. Fortunately the remedy is easy, and involves no apparatus, all that is required being a light wooden frame or a few light boards placed on the bedstead, underneath the mattress. If the mattresses are of the kind to be described directly, no discomfort will be felt after a very little time from the rigidity of these boards, even by those who are accustomed to lie softly, while they are quite as efficient as any special bedsteads that have ever been devised.

Size of bed. A big bed is a misfortune in all cases of sickness, but especially in fractures. The best size is that of the ordinary single bed, as found in hospitals and elsewhere, namely, 6 ft. 6 in. by 3 ft. or 3 ft. 6 in.

Mattresses. It is a matter of great importance that the *mattresses* in fracture cases should possess the qualities of smoothness and elasticity in perfection, and for this reason any form of "bed," either of feathers or any other material, is quite inadmissible. Flock mattresses are objectionable, as, even if they are well made, they tend in time to form knots or lumps. The best combination of all is a straw palliasse, and over that, one or two horse-hair mattresses, 3½in. to 4in. thick.* Over the mattress one blanket is generally found useful. The sheets, etc., require no particular directions, save that if a draw-sheet and macintosh are required, they should be arranged before the patient is put to bed.

In cases of fracture of the lower extremities, or of the spine, *all* pillows, bolsters, etc., are harmful, except the merest cushion beneath the head, at any rate in the early stages of union; and if the patient can be induced to lie thus flat, the position will not produce discomfort after the first day or two. Any pillows should be small and firm, and covered with separate slips.

Putting patient to bed.

The bed being ready, the patient, if completely disabled, should be very gently lifted on to it; the clothing should be removed, cutting off the boots and ripping up the seams of the clothes, if this has not been done before, the sound arm or leg being the one which should first be slipped out of the sleeve or trouser. As a rule, everything in the shape of temporary splints may now be taken off and the limb should be placed in the most natural position in which it will easily lie, on a pillow fashioned into a kind of trough. Sandbags are very often useful in restraining spasmodic movements or in steadying the limb. All pressure of the bedclothes must be taken off by a regular cradle, or one improvised out of some such thing as a bandbox split open. Lint dipped in some evaporating lotion may then be applied to the surface of the fractured limb. If the case be a severe one, especially if there be much spasm, a hypodermic injection of morphia will now be found extremely useful.

Directions for arranging the bedding in cases where continuous irrigation is required will be found under that heading.

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* The best are made thicker at the foot than at the head, but they are not always to be procured.

CHAPTER XII.

OF THE PERMANENT SETTING OF FRACTURES CONSIDERED GENERALLY, AND ESPECIALLY OF FRACTURES OF THE BONES OF THE FACE, UPPER EXTREMITIES, AND SPINE.

I.—GENERAL CONSIDERATIONS.

WE have now to consider this most important branch of the surgical craft, a branch in which failure brings discredit and blame out of all proportion to the credit earned by even a perfect adjustment, and though the blame is often unjustly bestowed, it must be confessed that not seldom, carelessness, or want of attention to details, or neglect of opportunities for experience, have permanently condemned many an unhappy patient to an ungainly, or partially useless limb.

Students in London hospitals certainly should not complain of lack of opportunities for practice, for in all, we believe, it is the custom to leave the setting of ordinary fractures to the house surgeons and dressers, and the experience they thus gain is one of the most valuable results of holding such appointments.

Importance of careful work and neatness.

No pains should be spared to get the adjustment of the bones to a nicety; makeshifts of all kinds should be avoided; the splints, cradles, etc., should be of just the kind and size required; the padding, elastic, firm and neat; the whole arrangement, in short, should be workmanlike and pleasing to the surgical eye. Nothing betrays the character of the work of the house surgeon and his subordinates more surely than the appearance of the fracture cases in his wards; in one ward the clothes may be thrown off any case of, say, a broken leg, with the certainty of finding the limb swinging free of the bed, with the heel well down, the splints, straps, etc., symmetrical, and the whole thing looking "like a picture;" while in another a similar inspection will show, perhaps, that the bandages have not been looked at for days, and have been pulled about by the patient in his efforts to scratch, until the limb, loosened from the splint, has slued itself half round, and there lies with the toes pointing, and the heel a couple of inches away from the foot-piece. In both cases, doubtless, the bones will unite, but with what a difference to the earning power of the patient, for months at least—for life perhaps!

Best time for putting up fractures.

What is the best time for putting up a fracture? To this there is only one answer: as soon as possible after it has happened. Swelling, and muscular spasm are thus diminished or avoided. But cases not infrequently happen, in which the old fashion of allowing some days to elapse and the swelling to subside *before* adjusting the fragments, may be advantageously followed. Such cases are those in which there has been much comminution and extravasation, with little spasm. Here, at first, it would be sometimes almost impossible to properly adjust the fragments; but if the limb be allowed to lie on a pillow, between sandbags, for a week or so, the blood will have been absorbed to a great extent, and the position of affairs can be more exactly ascertained.

Necessity for free circulation.

It must never be forgotten that a limb which is the seat of fracture, is one with its circulation much embarrassed, especially in the way of the return of venous blood. Under certain conditions of lowered vitality, it needs only a slight increase of this embarrassment, as by some unwise pressure or constriction by bandages or strapping, and the border line between life and death, between merely bruised and gangrenous tissues may be passed. This grangrene may be local and limited, but it may also assume that fierce and illimitable character which characterises the true spreading gangrene, and causes it to be one of the most dramatic of all surgical conditions. Here there is no attempt at arrest from first to last; confined to a finger one day, in twenty-four hours the whole limb may be dead, and twelve hours later, that peculiar emphysematous crackling which indicates decomposition beneath the skin, may be felt from the neck to the pelvis.

We do not assert that tight bandaging is more than one of many factors in a given case of acute traumatic gangrene; the general constitution, the nature of the injury, and other causes, all bear their part; still it is certain that cases occur, and that but too frequently, in which a careless or ill-considered constriction has been its main effective cause. In such a case, grave indeed is the responsibility of the surgeon.

Sir James Paget relates* how a piece of strapping placed round a thigh, above an operation wound, and overlooked for two days, was the cause of a condition of affairs not very different from that above described; and to the eloquent remarks of that great surgeon the reader is referred.

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* Clinical Lecture, 1875, p. 60. The whole lecture (on "The Calamities of Surgery") should be read by every hospital dresser before he begins his work in the wards.

Care in the use of strapping.

Adhesive strapping, it may be mentioned in passing, unless the material be spread on leather, always requires careful application when used for limbs; it is unyielding and very strong, and often the temptation to forcibly fasten a limb down to the splint in good position leads to a dangerous amount of compression. Properly employed it is extremely useful in fracture cases; it should, however, never be put round the limb alone, but always round the limb and splint together, and should rarely be put directly on to the skin without a layer of lint intervening. Even if undue tightness does not produce death of the tissues, in many ways it is harmful. It gives pain and aggravates spasm, while almost certainly, it is a cause of those cases of delayed union which give so much annoyance and disappointment. The reparative processes cannot be expected to go on quickly when the venous blood remains, perhaps for days, in engorged channels, and the lymph-canalicular system is distended to bursting.

The setting of the various fractures.

II.—OF FRACTURES OF THE BONES OF THE FACE AND OF THE UPPER EXTREMITY, AND OF THEIR SETTING; AND OF FRACTURES OF THE SPINE.

Of the skull.

Fractures of the skull. The concussion and other results to the cerebrum which follow upon such injuries to the head as fractures of the vertex, or of the base of the skull, are considered in the chapter on general emergencies, and since the major operations of trephining, or elevating do not come within the scope of this book, these fractures need not here be further mentioned, as they call for no mechanical treatment. The reader, however, may be reminded of the extreme ease with which effusion beneath the scalp may be mistaken for a depressed fracture of the skull. The accepted cause of this deceptive feeling of depression, is that there is a ring of fibrinous material round the margin of the effusion. Firm pressure in the *middle*, not at the *sides* of the tumour, will enable the finger to feel the bone undisturbed below, and it is to be noted that a real depressed fracture is never mistaken for this condition, which is surgically known by the name of *hæmatoma.* (See bruises, later.)

Of the nasal bones and cartilages.

Fractures of the nasal bones are common enough in surgical practice, and a lifelong disfigurement is the result of neglecting to remedy the displacement of the bones. In these injuries either the nasal bones themselves, or their cartilages, or the septum narium, or all of these structures, are displaced or broken. The first point to bear in mind is, that the sooner the parts displaced are put into position, the better and easier that restoration will be. The swelling may be very troublesome; to reduce it, hot fomentations will be found most useful. Leeches have been recommended, but for obvious reasons they can only be used very sparingly to the outside of the nose.

In most cases the line of treatment is a simple one. The displaced or depressed bones must be lifted into place again by manipulation, with such an instrument as a stiff steel director, inserted into the nostril; once replaced, they will generally remain in position, if not they must be kept there by plugs of lint or cotton, soaked in carbolised oil.

Displacement of the cartilages is more obstinate than that of the bones, and generally requires careful plugging with pledgets of lint, frequently changed, to cure the deformity. This is especially true of displacement of the septum, causing obstruction to the respiration through one nostril, catarrh of the mucous membrane, etc. In these cases the septum must first be straightened with an ordinary pair of dressing forceps, or if they are at hand, with the flat bladed forceps invented by Mr. Adams, and should then be kept in its place by appropriate plugs.

All attempts at moulding by pads, lint, etc., placed outside the nose, appear to be useless, but a carefully moulded gutta-percha "cap," is often very serviceable. In cases of old standing deformity, it is probable that the wearing of some such apparatus as the nasal truss devised by Mr. Adams would be of considerable use.*

Other fractures of the bones of the face, *e.g.*, of the zygoma, the malar bone, etc., occur so rarely in practice, and differ so widely in every case, that it would be but lost labour to lay down any general rules of treatment.

Of the upper jaw.

Fractures of the upper alveolar process, with more or less of the body of the maxilla, occur from great direct violence. In some cases, where this injury is not accompanied by general disorganisation of the face, the displaced portion of bone may be readily replaced by manipulation, and the fragments will as a rule stay in position; if not, unless the teeth of the lower jaw can be made to serve the purpose, an interdental splint may be fashioned as described in fractures of the mandible, or the teeth may be wired together. The accident is a very rare one.

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* *Vide* Medical Society's Proceedings. Vol. IV. p. 78.

Of the lower jaw.

Fracture of the lower jaw, on the contrary, is very common, and occurs with very varying degrees of severity. We will consider first those cases which may be satisfactorily treated by the general surgeon, who does not claim to possess the special manipulative skill which belongs more properly to those who have given particular attention to the surgery of the teeth and of the parts connected with them.

An ordinary fracture of the jaw occurs from direct violence, and is frequently compound. Provided that necrosis does not take place, this fact does not materially alter the process of union, or the treatment, and the fragments as a rule unite firmly enough.

In most cases it will be sufficient to carefully mould a gutta-percha, or plastic felt splint to the outside of the jaw, as shown in Fig. 101, and to fix it with a firm four-tailed bandage (see also Fig. 62), so that the upper teeth may fit to the lower ones, and thus serve as a natural splint.

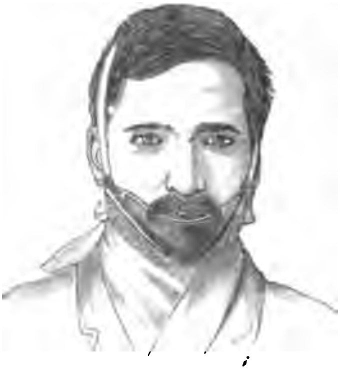

FIG. 101.—*Moulded Splint for Lower Jaw.*

The moulded splint should be fashioned out of an oblong piece of gutta-percha or felt, about 10 in. by 5 in. for an adult man (the size will, of course, vary), and must be cut down the middle of its length, except for about three inches in the centre, so that it is of the shape of the centre of the four-tailed bandage which has been before described. To mould and apply it, the four ends thus made must be folded up while it is warm, exactly as the bandage is. It will be wise to cut out a paper shape first to secure an exact fit. If it be necessary, as for the dressing of a wound on the chin, a trap door may be cut in the splint.

In more severe cases, additional firmness may be attained by fastening together the unloosened teeth on either side of the fracture with a stout silver wire; this with care is often of great service. Again a rough interdental splint may be made by warming and moulding a mass of gutta-percha of about the size of one's thumb, and pressing up the teeth on the side of the fracture into it, and when the fragments are in good position pressing the whole mass upwards against the upper teeth.

Loosened teeth should always be left alone unless they are obviously shattered. For the first week or ten days all food must of course be liquid, and for the first day or two it will generally be found possible to get nourishment enough taken through a tube, or poured in at the corner of the mouth. But the patient will soon manage to suck in and swallow fluids, and later on soft semi-solid food, without disturbance of the fragments.

Fractures of the jaw of ordinary severity, and which do not present unusual complications of displacement, may be successfully treated on the foregoing lines. Cases however will present themselves which require special apparatus and special mechanical knowledge to keep the fragments in good position. For the following account of the management of such fractures I am indebted to my colleague, Mr. H. Hayward.

OF THE TREATMENT OF SEVERE FRACTURES OF THE JAW REQUIRING SPECIAL APPARATUS FOR EACH CASE.

I.—OF FRACTURES OF THE LOWER JAW.

Of severe fractures of the lower jaw.

Until 1816 no advance was made upon bandaging as a means of keeping steady the broken ends of the lower jaw. About that time *Malgaigne*, *Lonsdale*, and others, suggested the plans of tying the teeth near the fracture together with silk or wire, or of boring holes in the alveolus on either side of the fracture, and then tightly twisting up wires passed through them.

The next distinct advance in this direction was due to Lonsdale, who employed an apparatus with a concave semicircular ivory groove as a cup for the teeth; this was fixed to a curved screw-bar, so attached to a lower padded chin-piece, that by the screwing up of a nut, the front teeth (if any were present) were tightly pressed on their cutting edges, and the jaws pressed up to the teeth. The chief objection I have always found to Lonsdale's splint has been its liability to catch in the bedclothes, and to be dragged out of position during sleep, and in any case a splint made on this principle would not be comfortable or trustworthy for mouths which were edentulous, or where molar teeth only existed.

Nevertheless, for cases of great displacement, especially if the fractures are compound, metal cap splints *can* be made (generally silver is used) which are able to fit the teeth and gums and keep the fractured ends of the bones and the teeth (if any) in absolute apposition, and the jaws in normal coaptation, but for this treatment to be successful, the attainment of an accurate model is a *sine quâ non.*

As far back as 1858 some cases of very serious compound fracture of the jaw with displacement came under my care, and in Mr. Christopher Heath's work on *Injuries and Diseases of the Jaw*, enough is quoted from my notes to give a fair idea of this method of treatment.

Methods of modelling.

There are two ways in which an exact model may be procured.

If the fractured bone can be held in accurate position while the model is taken in wax, carried in a well-selected dentist's impression tray, such as is used for modelling for artificial teeth, an impression may be easily and quickly made which will do quite well; but if there is much displacement or comminution, or if the jaw presents much swelling and tenderness, the forcible retention of the displaced parts long enough in position to secure a good mould is not possible, and the second plan must be resorted to.

This consists of taking a model of the displaced bone *as it is*, and then altering the cast from it by sawing it in pieces and again uniting these in their proper position. When the teeth are fairly numerous in both jaws, this task will be rendered much easier from the guides which the faceting of their worn surfaces will afford.

The fragments thus coapted may be retained in place with melted beeswax, and then a solid plaster of Paris mould may be made, upon which dies and matrices may be cast, on which again gold, silver, or platinum plates can be struck up (Figs. 102, 103), or vulcanite ones moulded.

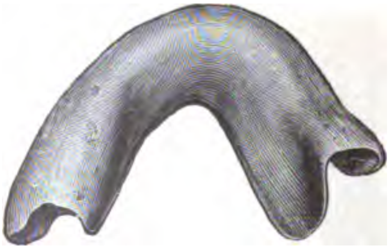

FIG. 102.—*Metal Cap Splint for Fractured Lower Jaw, seen from above.*

The metal splint.

To fit all the teeth and the gums for about one-third or to half an inch below the teeth on the tongue and lip side, this cap should extend back so far as to fit over at least the furthest back tooth which is embedded in a misplaced piece of jaw. If the fracture be compound, several holes should be drilled in the plate in those situations where the discharge takes place.

It is often sufficient to place this cap or plate in the mouth, and steadily press up the teeth into their proper receptacles, and then to bandage outside with the usual "four-tailed" bandage over a well-fitted gutta-percha socket, made to the horizontal ramus of the jaw after it has been set. The chief advantage of a metal plate is the comparatively small space it occupies in the mouth—the salivary glands soon cease to be stimulated by it.

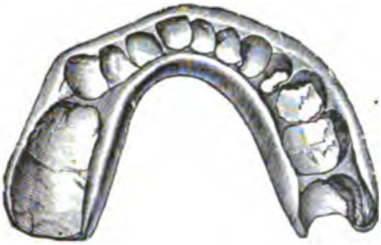

FIG. 103.—*Metal Cap Splint for Lower Jaw, seen from below.*

I have adopted numerous modifications, commencing in 1860, by lining the metal splints with chamois leather, gutta-percha, or vulcanite. But since 1862, in cases where there were either but few teeth, or when many were loose, or when, from the depressed condition of the patient, medicines or liquid food were frequently necessary, or when an excessive fœtid discharge necessitated repeated disinfectants, I have used *interdental* splints, with a space or spaces between them to allow either of tubes to feed with soup, or to wash out discharges.

Interdental splints.

In such cases splints have to be made and fitted to each jaw, and when the correct coaptation has been secured, the two pieces can be joined together by vulcanite, leaving spaces for tubes for feeding and for the use of antiseptics. As the author of this work has stated (page 160), gutta-percha, or gum resins, may be used as temporary interdental splints very conveniently, particularly in young mouths.

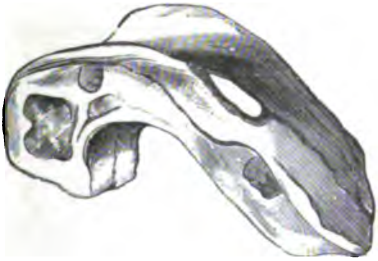

FIG. 104.—*Vulcanite Interdental Splint.*

Fig. 104 is a representation of the first interdental splint I made in 1860 for a patient with compound fracture of both jaws and displacement of the teeth in each. I used beeswax to take the first impressions, cast plaster into these, set the fracture by cutting through the plaster and fitting the teeth together, so as to secure the normal bite, making a vulcanite socket for each jaw so set, and subsequently, when comfortably fitted, uniting them together. In severe cases, at least one aperture between the splints should be made to pass a tube for food, or a syringe for washes. Such splints often require no bandaging, but if necessary, a four-tailed bandage may be used, or a chin-piece, with the ends sewn together at the back of the neck. This may be united to a skull cap made of india-rubber webbing, by a vertical piece in front of the ears. It is very desirable to sew all the parts, as the knots in tied bandages are liable to become loose during sleep, or to cause pain by their pressure on cutaneous nerves.

Of the upper jaw.

Fractures of the upper jaw, with or without broken or displaced teeth, are of much more frequent occurrence in civil practice than formerly, due chiefly to the development of football, cricket playing, and cycle riding.

The treatment of such cases is similar to and simpler than that of fractures of the lower jaw, as we have now a fixed basis for an interdental splint, or one fitting only to the teeth, gums and hard palate. The greater vascularity of the bones and soft tissues is an immense advantage, and for this reason any portions of bone having the smallest attachment to soft parts should be replaced in their normal situations, also teeth whose fangs are broken in their sockets, or those entirely detached should be replaced after being thoroughly cleansed in warm water and the coagula removed from their sockets. The recuperative power of the vascular tissues is so great that the most determined effort should be made to avoid the sacrifice of any part of the jaw, alveolar process, or tooth, which has any soft tissue connection. It is, therefore, especially important to replace the disturbed bones and teeth as soon as possible. Care must be taken if there is much comminution, not to pinch any soft parts between the broken fragments in replacing them, otherwise much pain, swelling, and delayed union will result.

Splint for.

When the fragments have been satisfactorily replaced, a gold, silver, platinum, vulcanite, gutta-percha, or gum resin splint, or a metal splint lined with gutta-percha or vulcanite, modelled as already described for fractured lower jaw, may be fitted if necessary.

The clavicle.

Frequency of the accident.

Fractures of the Clavicle. This fracture is stated by statisticians to stand fifth in the order of relative frequency, but it is probable that its real place is higher. The error (if error it be) having perhaps arisen from the tables being largely drawn from in-patient records, while the majority of these fractures are treated in the casualty rooms of hospitals, and may never come upon their books. Moreover, it is certain that in infants the fracture is often not recognised or treated at all.

At any rate the injury is exceedingly common, and every student may count upon seeing a sufficient number of cases. Yet there is no fracture about the setting of which text-books give more bewildering and contradictory directions.

The great points of difference are, first, as to the position of the arm, and especially of the elbow; second, as to the use of an axillary pad; third, whether some set form of apparatus, or strapping, or bandaging, is best.

Leaving unconsidered the varying questions as to the treatment of complex clavicular fractures which may arise in particular cases, the methods commonly employed for setting the ordinary examples of the fracture are here described.

Treatment by lying flat.

In the first place, there is probably only one way in which the fracture can be so treated that there shall be no permanent deformity, and that is by compelling the patient to lie absolutely flat and still, with a small cushion between the shoulders, until there is sufficient cohesion of the fragments to prevent any displacement. For this at least a fortnight will be required, and no bandage or apparatus of any kind is called for so long as the position is maintained, for the fragments come naturally into their places. When it is considered safe to trust to their cohesion, the arm must be fixed for a week or two in some one of the ways to be directly described. Few indeed will be the instances in which the patient will submit to, or the surgeon advise, so irksome a treatment, but it happens occasionally that perfect symmetry and grace are very important factors in social life or happiness, and for such patients the game will be worth the candle. But in most cases it will be generally undesirable even to confine the patient to bed; the fracture must therefore be firmly fixed in some way or another, even though absolute apposition be very difficult or impossible to attain.

Nature of the displacement.

Taking the case of the common fracture in the middle third; the deformity to be rectified is, when the patient is erect, a downward, inward, and backward displacement of the inner end of the outer fragment; the shoulder therefore requires to be elevated and to be pressed outwards and backwards; and to fix the parts in this position, the arm must be fastened to the side.

Conditions necessary for the replacement.

To attain this raising of the shoulder, all authorities are agreed that the elbow must be well pushed up, and most advise that a pad should be placed in the axilla; but whether the elbow should be carried forward across the chest, or should remain in the axillary line, or be carried backwards, are questions about which there is great diversity of opinion.

Cases naturally differ, but in most instances, we think it is easy to show that the arm, if it be carried well behind the axillary line, pulls the shoulder back with it, and rectifies the deformity, so that any plan by which the elbow may be pushed up, carried back, and kept there while the shoulder is forced outwards, will effect in most cases a satisfactory setting of a broken clavicle.

Treatment with an ordinary roller. These conditions are well fulfilled with a moderately broad roller bandage, and with a wedge-shaped axillary pad about two and a half inches thick at its base.* This latter being placed in position (pressure on the axillary plexus being carefully avoided) the arm is fixed in the line which best reduces the deformity, with the elbow well back and pushed up. The end of the bandage is then fastened round the arm just above the elbow with a clove-hitch (a soft handkerchief or lint may be put round the arm first to avoid chafing) and then carried backwards round the body and arm, which is placed across the chest. Movement of the arm being thus prevented, the bandage must be continued, at first horizontally, round the body and arm,

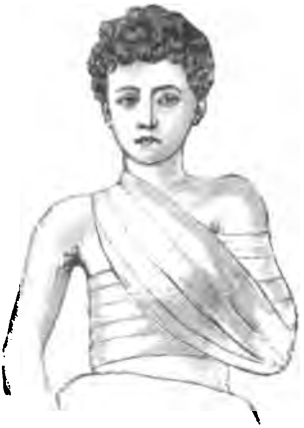

FIG. 105.—*Fractured Clavicle fixed with a Roller Bandage.*

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* This wedge-shaped cushion must be placed with its base or broadest part upwards, fitted into the top of the axilla. Tapes are often fastened to its corners to tie over the shoulder, and other shapes than the wedge are in common use.

from below upwards, until the limb is fixed to the side; and then a sufficient number of turns must be taken obliquely over the hand and forearm, and below the point of the elbow, so as to support it (a slit being cut there if necessary) until the hand and forearm are covered in. (Fig. 105.)

In hot weather it is advisable to dust starch or violet powder over the skin before the bandage is applied, especially in the folds of the axilla. However carefully and well the bandage may be put on, still it will get loose in a few days, and must be tightened up; the interval however may be considerably lengthened by rubbing a little starch paste into the folds of the bandage, a useful procedure, it may be mentioned in passing, in all cases where any length of bandage is employed.

Treatment by two triangles.

Although the roller is more generally employed than any other form of bandage in putting up fractured clavicles, a careful application of two triangular bandages, in the way already mentioned under the heading of the improvised treatment of these fractures, is more simple, and often effects the reduction of the fracture quite as effectually. As will be seen in Fig. 106, the scarf round the body binds the arm firmly to it, and the one passed obliquely under the elbow, and over the opposite shoulder, confines the hand and forearm, and pulls the point of the elbow at once

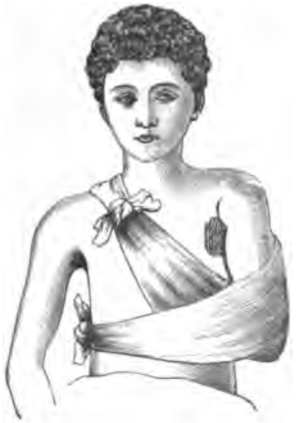

FIG. 106.—*Fractured Clavicle, treated by the method of two Triangular Bandages.*

backwards and upwards. The two triangular scarves being fastened in reef knots, can readily be tightened up. The rules as to the axillary pad are the same as in the previous case.

The fracture in infants.

In infants and very young children, incomplete fractures of the clavicle are very common, and are easily overlooked. It is almost hopeless to try to follow any fixed rules as to the setting of these fractures, but they generally unite with little deformity if the arm be brought to the side, the forearm and hand crossed over the chest, and the limb fixed in that position by strips of adhesive plaster (out of any ordinary bandage, a baby will wriggle in ten minutes); all precautions being taken to avoid chafing of the skin.

Fractures at clavicular or sternal end.

For the more infrequent fractures which involve the inner or the outer extremities of the clavicle, it is difficult to lay down any general rules of treatment. It may first be said, that in all cases where there is much displacement, the fracture should be put up on the same lines as if it were one in the middle third. If, however, the fracture be quite close to the sternum, any bandage which will confine the arm to the side, and the hand and forearm across the chest, for a fortnight, will suffice.

If again the fracture be near the acromion, and there is not much displacement, a shoulder cap of gutta-percha or felt, as in fractures of the neck of the humerus (*q.v.*) will be an efficient mode of treatment. Axillary pads in these last cases are not generally required.

Other methods.

The following modes of setting fractured collar-bones should not go without mention, for although we do not advise any one of them for general use, cases occur in which one or the other may prove of service.

The double figure of 8 for the shoulders, is recommended for cases of single or double fracture. It is very pretty on paper, but inefficient in practice.

Velpeau's bandage is classical, and is figured in almost all text books; but it is complicated, and brings the elbow almost to the middle line in front, the hand resting on the opposite shoulder.

Sayre's method.

Treatment by broad strips of adhesive plaster is a plan introduced by Dr. Sayre, which is now in very general use in this country. Although it is not without its drawbacks, it certainly is an efficient method of setting the fracture.

The principle and practice of this method will be understood from Figs. 107 and 108. Two strips of adhesive strapping are cut ("moleskin" strapping is the best), three to four inches wide, and of sufficient length. The arm being held in position, one piece is first fastened round it, just above the centre, and secured by a few stitches; the strip is then carried backwards round the body, and is fastened to itself behind, as shown in Fig. 108. The second piece is carried downwards from just behind the uninjured shoulder, and obliquely across the back, the point of the elbow is received in a slit, and the strapping is then carried up over the forearm and hand, which are flexed on the chest, and fastened at the place it started

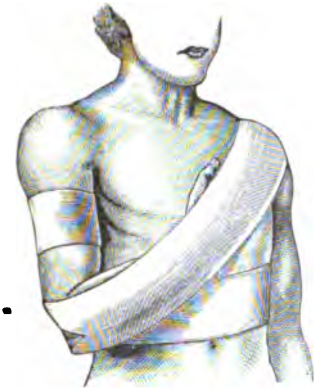

FIG. 107.—*Sayre's Method for Fractured Clavicle. (Front.)*

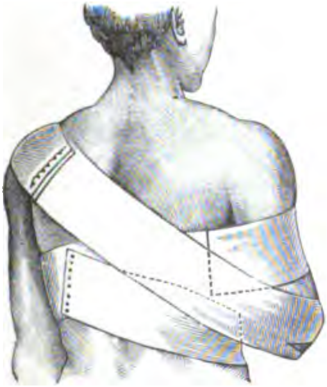

FIG. 108.—*Sayre's Method for Fractured Clavicle. (Back.)*

from. Dr. Sayre does not appear to use an axillary pad, but if it improves the position it should be employed.

The names only of the four following methods will be given for they are hardly ever used in this country. A full description of them will be found in Professor Hamilton's book "On Fractures," or in similar treatises.

Desaults' method.—Classical, but clumsy, and complicated.

Fox's "Ring, Sling, and Pad" has the disadvantages inherent to all set forms of apparatus, and does not confine the arm to the side. It is stated to be useful for fractures of the acromial or sternal ends of the bone.

Lewis' Apparatus.—A slight modification of Fox's.

Brasdor's Apparatus.—Designed to fulfil the indications of the posterior figure of 8, by means of straps and buckles.

Fracture of sternum.

Fracture of the sternum is rare, but may occur in consequence of direct or of indirect violence. Care must be taken in examining the thorax after injury, not to mistake some congenital or acquired in-curvation of this bone, for a fracture. The displacement, if there be any, can often be reduced by making the patient take an inspiration, or by bending the shoulder-blades back, or by laying the patient down over a sand-bag, or a wooden block placed under the middle of the back. The deformity however is apt to recur in an obstinate manner, and is then hardly amenable to treatment. In the course of time the parts will often come of themselves into fair position, so that they may be left alone unless, as sometimes happens, an embarrassment of breathing calls for special operative treatment. In ordinary cases, the ends being brought into as good position as may be, all that is required is a broad calico or flannel roller, applied as for broken ribs, or the double figure of 8 of the shoulders may be applied.

Fractured ribs.

The proceedings to be taken in cases of fractures of the ribs, differ widely with the nature and extent of the accident.

Taking the ordinary cases first, it will be found that the patient has been badly squeezed in a crowd, or has been run over by a light cart, or has suffered some similar injury. He complains of a catching stitch or stab on inspiration; he leans forward, and holds his breath as much as possible, and quickly learns that by pressing his hands to his sides, the pain and difficulty in breathing are lessened. On examination of the seat of pain (probably about the seventh or eighth rib), by firm pressure, obvious crepitus and mobility may often be detected, but this is by no means invariably the case, especially in fat people. The stethoscope will frequently detect the crepitus when the sense of touch fails to do so, but in any case, a sufficient injury, followed by symptoms such as the foregoing, gives presumptive evidence of one or more ribs being cracked or broken, and it will always be safe to treat the patient accordingly.*

In such a case, one, two, or three ribs may be broken, but they are still retaining tolerably firm relations with their fellows; the pleura is but slightly injured, and there is practically no displacement. Firm pressure on the thorax restrains the play of the ribs, and thus the source of pain is avoided.

Reasons for strapping both sides.

It may easily be shown that pressure on one side of the thorax does not control its movements appreciably; so long as the other side is free to expand, both will endeavour to work together. On the other hand it may be seen that in these slighter cases of injury to the thorax, not only are the diaphragm and abdominal muscles quite able to effect the oxygenation of the blood, so long as the patient remains still, but that actually a good deal more air can be drawn in with comfort, when both sides of the chest are restrained in their movements, than can be with difficulty inspired, if the uninjured side be left free to drag upon the hurt one.

Method of strapping.

For these reasons, it is advisable, that if it is proper to confine the play of the ribs at all, this should be done on both sides, and that the application of strips of adhesive strapping somewhat obliquely round the chest, is the best way to do this. The plaster is best spread on leather, but linen strapping is commonly used; it should be cut into strips 1½ inches wide, and long enough to be within three inches or so of meeting in front. The strips should be applied successively from below upwards, starting at the floating ribs. The surgeon, standing in front of the patient and applying the centre of the strip to the middle line behind, should bring the two ends, evenly and firmly, forwards and somewhat upwards, so as to compress the chest walls from behind forwards. The strips should overlap about half an inch, and should be continued as a rule, up to the third or fourth rib. Over the strapping a flannel or any ordinary bandage should then be firmly rolled, as shown in Fig. 109; this may be prevented from slipping down by the brace shown in the figure, which is simply made by tearing a hole in a piece of broad bandage and putting the head through it, so that it hangs down in front and behind. The bandage is put on outside this brace, the ends of which are then turned up and fixed.

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* The post mortem table teaches us how often, in cases of accident, fractures of the ribs are overlooked in the presence of other and more obvious injuries.

When the injury is less severe, it may be unnecessary to apply the strapping, a firm bandage being all that is required. In any case the patient will probably be unable to lie flat down in bed for some days.

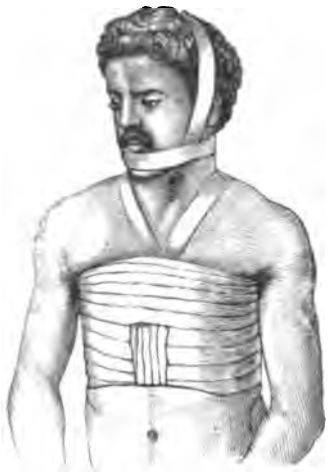

FIG. 109.—*Chest Bandage.*

Fracture from direct violence with injury to viscera, etc.

But the foregoing rules of treatment will have to be greatly modified or abandoned in the more serious cases where there is severe injury to the lungs, or great crushing of the thoracic walls; such an injury for example as that which the direct kick of a horse may inflict, where the rib, instead of being bent outwards until it breaks, is forcibly driven into the chest cavity; or where the whole chest wall may be crushed out of shape, and its bellows action almost or quite abolished. In such a case the dyspnœa will be extreme; the symptoms of hæmo- or pneumo-thorax may quickly develop with surgical emphysema, and hæmoptysis will almost certainly be present.

Under these circumstances it is clearly unsafe to put any further restrictions on the processes of oxygenation; indeed, no tight bandage or strapping would be borne by the patient for one minute; all that can be done locally, is to give a gentle support to the chest walls with a broad flannel roller. If one of the broken ends remains permanently depressed, efforts may be made by manipulation to elevate it; it has been suggested that the end of the portion which has retained its position should be depressed to the level of the other, in order that the two fragments may interlock, when the spring of the undisplaced end may raise the other with it. The deep inspirations produced by ether inhalation have been recommended, and have doubtless sometimes remedied the deformity, but from the nature of the accident, it does not seem advisable to subject these patients to the action of this vapour. The employment of any sharp hook to forcibly raise up the fragment is now generally condemned, and it should be recollected that this displacement tends to rectify itself by degrees, as with recovery, freedom of respiration advances.

Elevation of depressed parts of ribs.

The hæmoptysis is not generally dangerous in itself, but should be watched anxiously in consequence of the pneumonia which is apt to develop in the area of injury. If this occurs, there is a very serious increase in the embarrassment to the breathing, and great engorgement of the right side of the heart, evidenced by a quick hard pulse, and partial asphyxia. In such conditions, antimony, aconite, and similar drugs are indicated, but we believe that no treatment is so ready and effectual as a moderate venesection, which may be repeated if necessary. The good effect of taking away ℥vii or ℥viii of blood is most striking, and it is a pity that this is not more frequently done. The method of performing the operation of bleeding is described later.

Injury and hæmorrhage causes of pneumonia.

With regard to the surgical emphysema, it is rare for it to be a serious embarrassment, although it has sometimes, by spreading beneath the deep cervical fascia, caused difficulty in breathing or swallowing. It is best left alone, or controlled by bandaging only; but if it must be diminished—and cases are on record in which the features of the face were obliterated, and the whole body blown out—small punctures may be made, or, still better, several of "Southey's trocars" may be introduced into the cellular tissue, the ensheathing cannulæ, which must of course be strictly aseptic, being allowed to remain *in situ*.

Surgical emphysema.

The treatment of pneumo- and hæmo-thorax cannot here be discussed, but it must be founded on those general rules which are laid down in all systematic surgical works.

Fracture of the scapula.

Detailed descriptions of the various fractures to which the scapula is liable may be found in all text books on the subject. Individual cases, however, differ so very much that it is not easy to lay down general rules.

For the purpose of treatment, two forms of fracture may be distinguished, those, namely, in which there is an obvious dropping of the shoulder, and those in which this feature is absent. If this deformity be present the injury has a strong superficial resemblance to dislocation of the joint, from which it may be distinguished by the fact that pushing up the elbow causes the shoulder to assume its natural shape. In such cases it is best to do this, and to fill up the armpit with a pad. But whether there be dropping or not, the simplest and best way of fixing the scapula is to fit a gutta-percha or poro-plastic shield, of a shape similar to that which will be immediately described for the humerus, but rather larger behind, moulded so as to embrace and fix the arm as well as the shoulder blade. This shield may be made in leather, but inasmuch as it will not probably have to be worn more than about three weeks, this is not generally worth while.

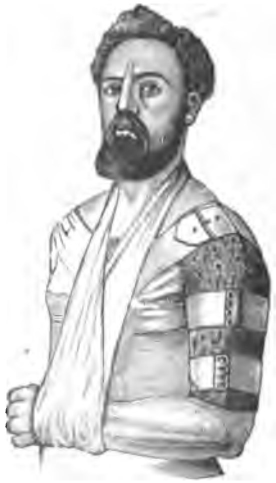

FIG. 110.—*Shield for Fracture of the Neck of the Humerus, etc.*

Fractures of upper end of humerus.

In fractures of the *anatomical neck of the humerus*, the shield just mentioned will prove very useful, without a pad in the axilla; but the elbow must now be allowed to hang free, with the hand only placed in a long sling. As a rule there is little or no deformity. This shield and sling are shown in Fig. 110.

If the fracture be at the *surgical neck*, the case is different. There may be little deformity, and that little may readily yield to slight extension, but in many cases the shortening is obvious and difficult to remedy. But, generally speaking, if the shield be carefully applied, and extension be kept up at the same time, good position will be obtained. In some obstinate cases it is advisable to place a stirrup on the arm in the same manner as for the leg (*q.v.*), and to make extension with a weight and pulley fastened to the side of the bed (to which the patient must be confined), the forearm being flexed over the chest.* In addition to this extension, the shoulder must be fixed with a moulded felt or leather shield, or a plaster of Paris spica. The weight will probably only be necessary for a few days.

Finally, slight fractures, without displacement, anywhere about the shoulder girdle, may often be efficiently treated without any other apparatus than a firm spica bandage, well starched, or saturated with plaster of Paris or gum and chalk.

Passive motion.

Passive motion must always be begun early. No joint is more often relieved by bone-setters, who break down adhesions which surgeons have carelessly allowed to form. This is particularly true of people advanced in years, or with any tendency to rheumatic arthritis or gout.

Fracture of shaft of humerus

Fracture of the shaft of the humerus is very common, and in most cases is easy to get into good position. It is frequently comminuted but seldom compound. With regard to the setting, it is impossible to say positively that any one or two of the many ways recommended are better than the rest, for indeed they will almost all give satisfactory results.

The ends to be attained in putting up this fracture are that the arm shall be fixed while slight extension is kept up in such a way that the forearm may be flexed and slung without obstruction of the circulation of the elbow. Thus, three or four splints, properly padded, fastened round the arm with a bandage or strips of plaster, or webbing straps and buckles, while an assistant keeps up moderate extension, will fix the fracture very well. These splints must be of different lengths; the outside one should extend from the condyle to the acromion, the inside and front ones should be much shorter, and particular care must be taken that when the forearm is flexed these do not press in the slightest degree either on the veins, the nerves, or the artery at the elbow. The inside splint may often usefully be a simple angular one fixing the forearm as well as the arm.

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* A stirrup and weight have been recommended to be applied in such cases, without confinement to bed. But it is found that the swinging of the weight with every movement of the body, by keeping up muscular spasm, undoes all the good effect of the extension.

Precautions for free circulation at bend of elbow.

In whatever way the arm be put up, the troublesome operation of bandaging the fingers, hand, and forearm, to prevent swelling, may generally be omitted. It is better to sling only the hand and wrist, leaving the elbow free.

Another good plan is to put up the limb in plaster of Paris, with or without wooden splints as well; or kettle holder splinting with webbing straps; or a moulded splint may be fashioned out of gutta-percha, leather, or poroplastic felt, the best way being to cut out the material so that the splints fit like a cap over the point of the shoulder and grasp two-thirds of the circumference of the arm, the inside third being supported by a short, straight, wooden splint, and the whole fastened together with webbing straps; the splint will be much of the shape of Fig. 110.

Measurements.

Careful measurements should always be taken in these and other fractures of the humerus. The best line to take is the lower and back part of the acromion process, where a sharp edge of the bone can always be felt, to the *point* of the elbow in the middle of the olecranon; this is a more exact spot than the end of the external condyle.

Delayed union.

Although, and perhaps to some extent because, this fracture presents little difficulty in the setting, it is more frequently followed by delayed or non-union than any other. Immobilisation therefore must be very rigidly carried out, and any obstruction to the circulation guarded against. It is probable that one cause of failure is a tendency for the natural movement of the elbow to be transferred to the seat of fracture.

If at the end of three or four weeks when the splints are taken off, it be found that union has not advanced properly, but that there is some partial cohesion, the fracture should straightway be put up again (best in plaster of Paris), and not touched for another month, when union will generally be complete. If, on the other hand, the fragments seem as movable, or more so, than at first, and there is an ominous absence of pain and swelling, the best plan is to take off all splints for three or four days, during which time the fragments should be freely and frequently rubbed together, until swelling and tenderness of the parts are produced. The arm should then be put up most carefully and left undisturbed for six or seven weeks. If at the end of that time there is still no union, the case may be said to be one of "non-union," progressing towards a false joint, the treatment of which does not fall within the scope of this work.*

False joint.

Fractures about the elbow.

The differential diagnosis of fractures from dislocations of the elbow-joint, and of the various forms of these fractures, one from another, is always considered very fully in systematic surgical works, and it is quite true that it is most important to know whether we have to do with the one or the other, or what is more probable, with both the one *and* the other; this question, however, will almost always be solved during the manipulation which will in all cases be necessary for the reduction of the deformity.

The different ways in which the bones forming the elbow joint may be broken, are so numerous, that hardly two fractures in this situation can be quite alike, and yet the same general rules of treatment will apply to the great majority (with the exception of fractures of the olecranon process).

Reduction of deformity.

Briefly stated, the best line of treatment to be followed in most fractures in the neighbourhood of the elbow joint (with or without dislocation) consists in making manual extension and counter-extension till the deformity disappears, and then fixing the limb, flexed at right angles at the elbow, upon an angular splint (as those shown in Figs. 84 to 87). One very efficient way of making this extension is to flex the forearm over the surgeon's knee, or over a firm body, such as a roller bandage, placed in the bend of the elbow, thus, so to speak, unlocking the joint; but various manœuvres will have to be employed in different cases, and although in not a few of those in which dislocation is present, some deformity and hampered movement will remain, it often happens that in the course of years, elbow joints deformed so that the ordinary landmarks have been lost, recover a freedom of movement well nigh perfect.

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* I have on two occasions seen such cases cured of their delayed union by being sent to the College of Surgeons for the purposes of the clinical examination; on their return the limbs were firmly fixed in plaster splints and did well. The union was evidently accelerated by the manipulations of the candidates.

Splinting. If the common angular splint be used, it should be placed on the inside of the limb, and must be well padded; the hinge joint (which all these splints should have) should be first firmly fixed with the two pieces at right angles to each other. The forearm piece should extend to the ends of the fingers.

The limb must be settled on the splint, with the forearm midway between pronation and supination; bandages and strapping may be used to fix it. If the elbow be very much swollen it may be left uncovered to allow of an ice bag being applied, while, on the other hand, it will often be advisable to mould over it an external gutta-percha cap splint, to be secured to the inner one by webbing straps.

In many cases an angular trough splint, fashioned out of poroplastic felt, or leather, as previously described, will be the best way of putting up these fractures. (Fig. 111.) For pattern see also Fig. 94.

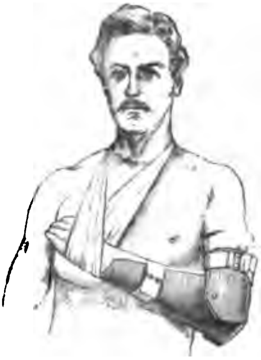

FIG. 111.—*Moulded Angular Splint for Elbow.*

If the œdema after reduction is not excessive, immediate splinting with plaster of Paris or silicate of potash is a very good plan, but care must be taken not to run any risk of thus deferring too long passive movement of the joint.

Passive movement. In all cases of fracture into, or near the elbow joint, the necessity for early passive motion must be kept in mind. If a jointed angular splint of the ordinary pattern be used, it should be so far shortened as to allow of movement of the wrist and fingers within a few days of the accident;

after ten days the screw clamp at the elbow joint should be released, and a little later, the limb should once or twice a day be removed from the splint, and flexed and extended. In no joint is the formation of ligamentous adhesions and stiffness through muscular spasm, more readily and insidiously set up. If fixation does occur, the joint must be freely moved under an anæsthetic, and this proceeding will probably have to be repeated more than once or twice.

Fracture of the olecranon.

Fracture of the olecranon is very troublesome when it is complete, whether it occurs by direct violence or through muscular spasm (if this last ever happens). If, however, as often results from a fall on the elbow, the process is merely chipped, and the triceps muscle still remains attached to the ulna, the actual fracture needs little attention, and the arm may be flexed and put up in a trough splint as in an ordinary case of injury to the elbow. Whether the splinter unites or not will matter little.

But if the fracture involves a separation of the triceps attachment, there is a great risk of permanent loss of the power of extension. The fragment to which the tendon is attached is drawn up the back of the arm, and it is difficult to keep it down close to its proper position. Still, if the arm be kept on an anterior splint, moderately, but not extremely extended, these fractures commonly unite well enough, though by ligamentous tissue; something, too, but we think, not very much, may be done by endeavouring to bring the fragment down with strapping, as in fractures of the patella, which these cases in many ways resemble.

Fractures of the forearm.

The common "*broken arm*" occurs in consequence of direct violence; as a rule both bones are broken, somewhere about the middle, and there is often a good deal of displacement. This, however, is readily reduced by manipulation, and no further restraint is required than that which two straight splints properly padded, and a sling will afford. The splints should be placed, one on the front, which should be long enough to reach from the elbows to the tips of the fingers, and the other on the back of the forearm, reaching to the wrist only. The forearm itself must be flexed and placed midway between pronation and supination, with the thumb upwards. It is not at all necessary to place a small pad between the radius and ulna, but occasionally there is a tendency towards a *sagging* of the ulnar fragments in the middle, which may easily be remedied by a very small wooden splint placed between the other two, along the subcutaneous edge of that bone. The fracture is often rather slow in uniting, a fact which may facilitate the correction of a faulty position.

These fractures of both bones of the forearm do not lend themselves kindly to the immediate treatment by plaster of Paris, for the fragments require more frequent inspection than in most other fractures of common occurrence.

The shaft of either of the bones of the forearm may be broken separately, and in most cases there will be little difficulty in keeping the fragments in position with splints similar to those used when both the radius and the ulna are broken. But if the radius be broken about the point of insertion of the *pronator radii teres*, the fragment may project forwards, requiring careful padding of the palmar splint, and flexion of the elbow beyond a right angle.

Colles' fracture.

In Colles' fracture, numerous plans and mechanical contrivances have been devised to disengage the impacted fragments of the radius, and to replace the hand in the natural position. We believe, however, that few, if any of them, in ordinary hands, will be found so efficient as the more simple and straightforward way by manual extension, adduction of, and pronation ("Tug, twist, and turn," Jones).

The detailed surgical anatomy of this fracture may be found in any work on Systematic Surgery, so that it will only be necessary here to remind the reader that the lesion consists of a fracture of the radius, or more rarely of a separation of its lower epiphysis, at a point not more than an inch and a half above the wrist joint, with some impaction of the shaft into the separated end; and further, that it almost always results from a fall on the outstretched palm. The impaction, therefore, will always be in direct relation to the violence of the shock.

Reduction of the deformity.

To unlock the impacted fragments and otherwise reduce the deformity, it will be necessary to make forcible extension, and at the same time to powerfully pronate and adduct the hand towards the ulnar side. This is most readily effected while an assistant makes counter extension, by hooking his elbow round that of the patient. Given a sufficient force, in all ordinary cases, the limb must come into good position.

Pistol splint.

It is still very generally held that this adduction must not only be made for the reduction of the deformity, but must be maintained during the whole time the fracture is uniting. For this purpose the common pistol-shaped splint is devised, to which, when it has been padded, the palmar surface and front of the arm is bandaged while extension is kept up, thus securing both this object and that of adduction. A short wooden splint is then laid along the dorsal aspect of the arm as far as the wrist. Two pistol splints are sometimes used, but this is a needlessly clumsy fashion, and in this country it is rare to find the pistol applied to the dorsal surface, although this was advised by Nélaton.

Two straight splints.

More simple still is the method commonly employed at St. Bartholomew's and other London hospitals, with equally good results, namely, the employment of two straight splints, back and front. These should be very smoothly and firmly padded, and should reach from just below the bend of the elbow to the ends of the fingers, and should be wide enough to overlap the width of the arm, and of the hand at the knuckles, not counting the thumb. The anterior splint should first be taken up and placed ready to be adjusted to the limb. The deformity is then reduced by extension and adduction, and while this extension is still kept up, the limb is laid on the splint, palm downwards, with the hand only slightly adducted. A soft wedge-shaped pad of lint is then placed on the back of the hand, the thick end being at the wrist, and the other ending at the knuckles; the dorsal splint is then put on, and both are firmly grasped at both ends by the assistant, so as to hold the limb between them in position. Two or three strips of strapping will serve best to hold the splints together, and are perfectly safe if the splints are of the proper width. They are then finally secured by a roller bandage, and the limb is slung. The object of the dorsal pad is to prevent the risk of damage to the prominent and ill-nourished parts at the back of the hand; it is an important precaution, as sloughing may, and does not infrequently, occur there very insidiously. Fig. 112 shows diagrammatically the way in

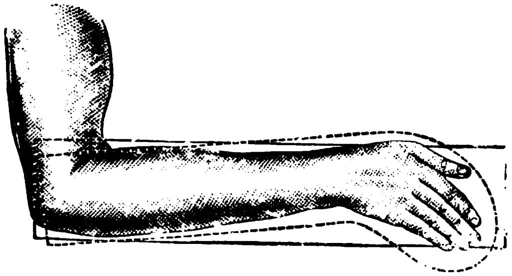

FIG. 112.—*Position of Hand and Arm after Colles' Fracture on Straight or Pistol Splint.*

which the hand and forearm should lie either on a pistol splint with a moderate curve, or on a straight one.

Early movement of fingers. In three days the fracture should be looked at, to see that the reduction is complete, and the hand in a satisfactory condition, and at the end of the first week the palmar splint should be shortened to the clefts of the fingers, and these latter moved, first passively, then actively. In ten days both splints should be shortened nearly down to the wrist, and in a fortnight, passive movement of the wrist should be begun. From this time the joint must be gradually brought into working order, though a light palmar splint should generally be worn until the end of the fourth or fifth week. Union never fails, and very rarely indeed is delayed.*

Moulded splints. Moulded splints of various patterns have naturally been used in the treatment of this fracture, either from the first, or in the later stages, and though we do not think that, taking the cases all round, this method is quite so suitable as the use of wooden splints for hospital cases, still there can be no doubt that the plan of treatment is a very good one.

Macleod's splints. A very good pattern and material for a moulded splint is the one made of poroplastic felt which has been described by Professor G. H. B. Macleod, and which is figured here (Fig. 113).†

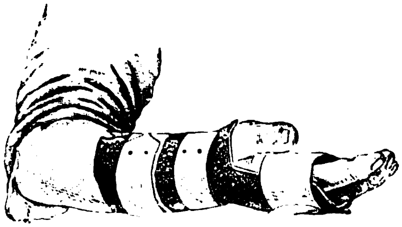

FIG. 113.—*Macleod's Splints for Colles' Fracture (the Palmar Splint is not shown).*

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* Mr. Robert Jones, of Liverpool, in a recent exhaustive paper on this subject, says that if the fracture be thoroughly reduced, early passive movements or shortening of the splints are both unnecessary, and harmful as leading to increased production of callus. He advises that, after reduction, the forearm, hand and fingers should be kept splinted for a full five weeks. (Analysis of 105 cases of Colles' fracture. *Liverpool Medico-Chirurg. Journal*, July, 1885).

† *British Medical Journal*, Vol. II. 1878, p. 79.

The splinting is effected by two pieces of the felt, the one, an oblong, about 10-in. by 5-in. with a corner cut out of it (so that the thumb is left partly free) is warmed and moulded to the wrist and back of the hand while the parts are held in good position by an assistant, and the second and smaller piece is fitted to the front of the wrist to oppose the tendency to the forward projection of the radius.

Carr's splints.

Another plan for the reduction of the displacement caused by this fracture depends upon the extension which bending of the fingers will effect upon the lower end of the fractured radius. The splints which are used for this purpose are known as *Carr's splints*, and their application will be sufficiently explained by the illustration (Fig. 114).

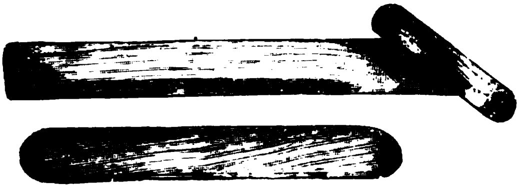

FIG. 114.—*Carr's Splints for Colles' Fracture.*

Gordon's splints.

Gordon's splints (Fig. 115) again, aim at the reduction of the displacement peculiar to Colles' fracture, by a combination of palmar, ulnar, and dorsal splints. The application of this apparatus also, will be understood from the figure. In London this method of treatment has not been often used; its especial merit would seem to be the freedom of the fingers for passive or active movement from the first.

Other fractures about the wrist.

The other fractures which may occur about the wrist hardly call for special notice. They must be splinted and treated on general principles.

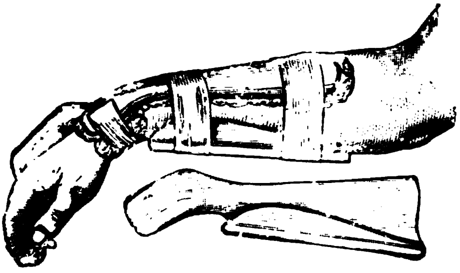

FIG. 115.—*Gordon's Splints for Colles' Fracture.*

Of the metacarpal bones.

Fractures of the phalanges of the fingers are not generally difficult to maintain in good position. Broken metacarpal bones, however, often project on the dorsal surface very awkwardly, and from the thinness of the skin the surgeon rightly hesitates about applying much direct pressure. The best way of reducing this displacement is to lay the forearm and hand on a palmar splint, to which a pad of the size and shape of an ordinary roller bandage (which itself is what is generally used) has been fastened so that the fingers may be completely and securely flexed over it. The combined extension and support thus afforded will keep the fragments in good position.

Of the thumb.

Fractures of the thumb, especially those of the first phalanx, are rather common in boxing, or in machine accidents, and from the nature of the injury are often compound, complicated by necrosis, disease of the articulation, etc. A simple fracture is easily enough set, and in most cases a moulded splint of gutta-percha will be the best way to fix the fragments; felt may also be used, or, with a little care, a neat spica of the thumb, made with a narrow bandage well loaded with plaster of Paris, will prove a very efficient support.

The fragments are sometimes rather slow in uniting; if delayed union be threatened the bones should be very rigidly encased.

Fractured spine.

The justifiability of any active and immediate treatment of serious fracture of the spinal column is still a vexed question; it may be said, however, that evidence is accumulating year by year which goes to strengthen the position of those who hold that the condition of mixed fracture and dislocation which results from severe spinal injury, and which is accompanied by deformity and paralysis, may sometimes be rightly subjected, soon after the accident, to such active manipulation and extension as may seem calculated to replace the dislocated bones or fragments.*

When the cord is not seriously injured.

The treatment of those cases of spinal fracture, in which the cord escapes serious injury, and which may almost perfectly recover, resolves itself into a question of the kind and amount of support the injured column will require. This will not differ materially from that commonly adopted in cases of spinal caries, which will be discussed in a later chapter. Where there is merely a breaking off of some of the spinous or lateral processes, little or no special treatment is called for. The muscles of the back will certainly be stiff for many days or weeks, but this must not be mistaken for the rigidity which is a symptom of true spinal mischief. Rest, properly maintained, will be all that is required, and the fragments may be left almost to themselves.

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* See for examples, *Lancet*, Vol. II., 1882, pp. 619 and 658.

When the cord is badly hurt.

If, however, the spinal canal itself be broken, the symptoms of paralysis arising from the necessary injury to the cord, rather than from the fracture of the bones, will call for attention; the amount of paralysis will of course vary with the situation of the fracture, and the chief distinctions between fractures in the different regions are sufficiently laid down in all surgical text books.

Transport.

The precautions which must be borne in mind in the transport of these patients have already been considered. Once brought home or to the hospital, the first point to bear in mind is the prevention of bed sores (*q.v.*), which in these cases may form with astonishing rapidity. If possible, the patient should be placed on a large water bed from the first, and in any case all the precautions mentioned later under this head must be most strictly observed.

Bed sores.

Other complications.

The urine and fæces very often give trouble from the beginning; as a rule there is retention of the former and incontinence of the latter, but exceptions are frequent. For the incontinence, incessant watchfulness, the use of draw-sheets, charcoal, marine tow, and other nursing appliances will be required, and for the former, regular catheterisation, with the softest and cleanest instruments possible. But all care will probably soon prove ineffectual to prevent vesical catarrh, alkalinity of the urine, and all the troubles attendant upon this condition; these must be combated by washing out the bladder. Alkalies and other internal remedies may also be given.

A low form of congestion of the lungs is very apt to be set up. It is best met by change of position, if the case will allow of it, but too often it will run its course unchecked. Sandbags placed along the trunk, neck, etc., will be found the best means of immobilizing the spine in the neighbourhood of the fracture. Hopeless as the majority of these cases are, still all hope should not be given up, for instances occur in which repair of the spinal column, and return in whole, or in part, of the functional activity of the cord take place, and in which power over the sphincters and the limbs returns, so that after long periods of helplessness the patients are enabled, aided at first by proper support, to resume a somewhat active life. The most promising cases are those whose paralysis is limited, and can be localised in the lower parts of the cord, or who present the symptoms of limited hæmorrhage in the spinal canal as being the real cause of the paralysis, by mechanical pressure of the clot, the cord itself being only indirectly injured.

CHAPTER XIII.

OF FRACTURES OF THE PELVIS AND LOWER EXTREMITY, AND OF THEIR SETTING.

Fractures of the pelvis.

FRACTURES of the pelvis are generally "run over" cases, and vary greatly in severity; their diagnosis is often obscure, and the fact of the patient being able to walk after such an accident does not exclude the possibility of this injury having happened. Little can or need be done in these cases beyond confinement to bed, and the application of a broad belt, or strip of adhesive strapping, round the pelvis. The thighs should be tied together and the knees bent, and supported on pillows. If the sacrum or coccyx be injured, a circular or horse-shoe cushion will be required, or the parts may have to be replaced by manipulation within the rectum, the subsequent formation of hard fæces being prevented by laxatives.

In cases of serious injury, the condition of the bladder, the urethra, and the rectum, will be the most important points calling for attention. Where the pelvic arch has been thoroughly crushed, the accident is usually fatal from shock immediately after the accident, or the later results of extravasation of urine, profuse suppuration, necrosis of the pelvic fragments, the development of pyæmia, or the like; but in other cases the urethra may be torn, or there may be retention of urine through nervous shock or injury (short of rupture) of the bladder. The procedure in the former case is considered later (*vide* rupture of the urethra), but if the retention be only due to temporary paralysis of the coats of the bladder, the catheter should not be immediately used, inasmuch as hot fomentations, or a poultice, placed over the suprapubic region will often cause the bladder walls to recover their power of contraction. If the urine be not passed naturally in a few hours, then it must be drawn off with a soft catheter. It will be better in all cases to employ enemata once a day, to prevent straining during any action of the bowels, and they will be absolutely necessary if the damage has been at all severe.

Retention of urine.

It appears then, that with the exception of the necessary treatment of symptoms caused by shock, or bruising, or some more serious injury to the bladder, urethra, or rectum, cases of fracture of the pelvis, are either so hopeless that little *can* be done, or so favourable that little *needs* to be.

Of the neck of the femur.

In the neighbourhood of the hip joint, the femur may be broken in various ways. Thus the symptoms will be widely different according as to whether the fracture occurs to an adult or to an aged person—from direct or from indirect violence—within, or without, the capsule—with impaction, or without it. But in practice all cases will fall under one of two headings—those, namely, in which an attempt should be made to secure a bony, or at least a firm union, and those in which such an attempt would either involve a risk to the patient's life, or would be obviously hopeless.

May be divided into two chief classes.

1. In which union is to be tried for, and

The rule commonly given is that intra-capsular fractures occur to aged people, and that in them bony union is not to be expected or tried for, while the exact reverse in all respects is the case for extra-capsular ones. We believe, however, that this generalization is too dogmatic, and that *all* fractures about the hip joint, which occur in consequence of an adequate injury (as opposed to a nearly spontaneous snapping across of the bone), should be treated as if union were to be expected, except those which happen to patients who are constitutionally aged, or the subjects of severe chronic bronchitis with emphysema, or cardiac incompetence, or some other condition which renders lying down dangerous or impossible.

2. In which it is not.

On the other hand, fractures, primarily due to the degenerative changes of old age, as those happening from a sudden twist in bed, a step from an unexpected stair, or the like, or which occur in people whose heart and lungs, under ordinary conditions, are barely competent, must be so managed that the accident shall be attended with as little extra risk to life as possible, but with a clear understanding that disablement must remain.

It is true that among the cases in the first class there will be some in which failure of union will unavoidably occur; but Mr. Hutchinson and others* have clearly shown that the old belief that union of intra-capsular fractures was a practical impossibility is founded on error, and if the cases are properly selected, no risk to life or other harm will result from attempts to obtain this result.

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* See Illustrations on Clinical Surgery; Fasciculus XI., Churchill, 1878.

Nor does mere length of years necessarily preclude union; age must be measured by the power of recovery yet retained by the tissues.

Treatment for union.

Supposing the case to be one of those in which a useful union seems to be possible, and in which it should be tried for (as in the usual extra-capsular fracture in an adult), a long splint, generally of the pattern known as "Ferguson's" or "Liston's" (Figs. 116, 117) will almost always be necessary. If one plan is to be advocated before all others we should advise the use of one of these splints, combined with extension by a stirrup and weight and with counter-extension by raising the foot of the bed, in precisely the same manner as will be presently described for fractures of the shaft of the femur (*q.v.*); but if the shortening be but slight (not more, say, than about half an inch), the long splint alone may be sufficient. In all cases great care must be taken to correct the eversion, which is even more marked in fractures of the neck than in fracture of the shaft. For this reason treatment by extension alone is unwise, although it has been recommended.

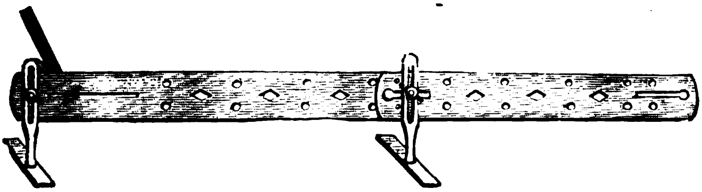

FIG. 116.—*Ferguson's Long Splint.*

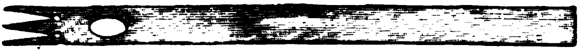

FIG. 117.—*Liston's Splint.*

Our objections to a perineal band as a means of extension are given later, and apply with equal force to this as to other fractures.

The patient must lie quite flat, the merest apology for a pillow being allowed for the head. The splint should be kept on for five or six weeks, and if at the end of that time union has not taken place, the attempt had better be given up, unless the case be one in which the union should be confidently expected. In any case the patient should have a firm spica of gum and chalk, plaster of Paris, or of some other stiff material put on, or a moulded felt splint of the pattern of Fig. 118 (the shape of which is given in Fig. 94, No. 1), and should then begin to get about; the stiffness of the joint and surrounding parts will have to be treated by passive movement and shampooing.

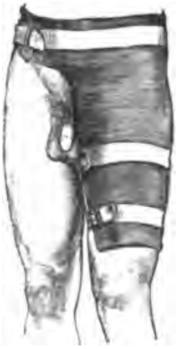

FIG. 118.—*Moulded Splint for Hip and Thigh.*

Treatment when no union is expected. If the case be one in which no union can be expected (as in most cases of intra-capsular fracture in old people), or in which the patient is a bad subject for prolonged lying down, it will be advisable to let her (for it is chiefly among women that this accident happens) stay in bed, propped up with pillows, if necessary, until the first shock of the injury and the worst of the muscular bruising have passed away, when a spica bandage, or moulded splint, may be put on as in the former case. The patient must then begin to learn to get about on crutches, and may eventually come to manage pretty well, although of course there is permanent lameness.

Danger of shock. The shock of the accident is often in feeble people severe, out of proportion to the actual damage to the tissues, and great care may be required to prevent an immediately fatal issue. The bladder, also, will often not act for some time, calling for the application of hot flannels to the abdomen, or use of the catheter.

Of the shaft of the femur. Except in children, the force required to break *the shaft of the femur* is very great, and the injury to the soft parts correspondingly severe. Failure, or delay of union is also not uncommon.

In the middle third. Taking first the most common variety of this fracture, that namely in which the shaft is broken somewhere about its middle, from direct violence, we find that there are

The three common requisites.

several ways in which the limb may be put up. The largest group of methods is that which involves the use of Liston's long splint (Fig. 117), the purpose of which is threefold—to fix the thigh fragments in a straight line, to produce extension from the leg and foot, and to serve as a rigid girder, lying along the trunk as well as the limb, so as to make the body inflexible in all its length.

1. A girder splint giving some extension.

In some few cases the application of such a splint is sufficient by itself, but in most it is found that the distorting action of the powerful thigh muscles is too great to be overcome without some further extension, and the employment of counter-extension as well.

2. Further extension as by stirrup and weight.

The use of the stirrup and weight, introduced first for extension in hip disease, was soon applied to fractures, and remains the most efficient way of overcoming muscular spasm.

The combined extension of the splint and stirrup would, however, especially in those cases in which its necessity was most imperative, result in a gradual pulling down of the patient's body to the foot of the bed, if some provision for *counter-extension* were not made. Until lately the usual way of effecting this was by means of a "perineal band" or padded strap, which was passed round the crutch, and then both ends were fastened, either to the head of the bedstead, which was most efficient, or to the top of the long splint, which was most usual. It is now recognised that there are many objections to this band; it is difficult to keep it clean, or to maintain proper extension by its means without running the risk of making sores, and it is probable that its days are numbered.

3. And counter extension.

As by raising foot of bed.

Fortunately a much easier method of counter-extension is at hand, namely, by raising the foot of the bed with two blocks of wood eight to ten inches high placed below the castors, and by taking away everything, except the smallest pillow, from under the patient's head. This slight head-downwards incline makes a very effectual counter-extension, the weight of the body being the passive agent: and provided that the thoracic organs are healthy, the position is well borne after a short time, even by those accustomed to sleep with their heads well raised.

The best general plan of setting.

The combination of the *long splint, the stirrup and weight*, and the *raising of the foot of the bed*, seems, therefore, to be the best *general* way of setting these fractures, and the application of the splint and other details must now be described.

Choice of splint. Many points will require attention in order to ensure success in putting up a fractured thigh by the combined means above mentioned. The first thing to be done is to measure the distance from the axilla to the outer malleolus on the uninjured side, and to select a Liston's splint of such a length that the outer ankle bone corresponds to the hole cut for it, when its upper end fits exactly into the top of the axilla. This is very important for the extension, for if too long there will be swelling and numbness of the arm, and if too short it will not be efficient. A foot piece is often added to this splint, but this will interfere with the proper position of the foot; a flat horizontal cross-piece, however, so fastened to the under edge of the lower end of the splint, that it keeps it upright as it lies on the bed, is very useful (or a metal foot, as shown in Fig. 116, may be attached to the splint). The end of the splint must be deeply notched, as shown in the figure, for the bandage, and should then be very carefully padded.

Application of stirrup. The patient lying in bed will probably have the leg much rotated outwards, and the thigh shortened and deformed. With as little disturbance of the limb as possible, a flannel or domette roller should be applied firmly to the leg and foot, reaching to just below the knee.* Over this *the stirrup* must be put on, thus:—A piece of wood about a quarter of an inch thick is taken (it should be square and the width of the ankle at the malleoli), and placed in the middle of a broad strip of strong strapping; this wood forms the foot piece of the stirrup, and the broad strip is fastened to it by some more strapping wrapped round it. The side strips of the stirrup are then warmed and adjusted to the tibial and fibular sides of the leg over the flannel bandage, so that the foot piece is quite parallel to the sole of the foot: it is then firmly fastened on by overlapping strips of strapping, put on obliquely, as shown in Fig. 119, from the ankle upwards. A roller bandage may be put over all, but this is not generally necessary.†

A neater and more comfortable, but a more expensive way, is to use strips of white basil leather, spread with some adhesive plaster. These are put on in the same way as the strapping, and look very workmanlike. The leather strapping is especially useful in stirrups for hip disease (*q.v.*) where it often happens that the branny, ill-nourished skin breaks down under the pressure of the rigid linen. In extremely tender cases, even chamois leather strips may be used. Fig. 119 shows an ordinary stirrup and weight, attached to the leg before the splint is applied.

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* The stirrup is sometimes put directly on to the skin without ill effects, but this is, we believe, running an unnecessary risk, though it be but a slight one.

† The side pieces of the stirrup must be kept from sticking to the malleoli by guarding the adhesive surfaces, for two or three inches at the ankle, with two bits of the plaster of the same width, put face to face with the side pieces.

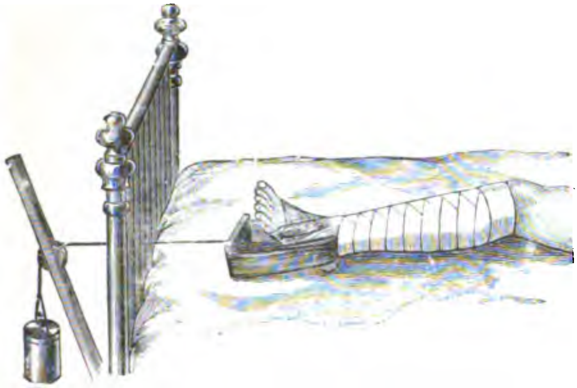

FIG. 119.—*Stirrup and Weight Adjusted to Leg.*

The stirrup being adjusted, the long splint must be fastened to the body, thigh, leg, and foot (Fig. 120), in a manner of which the following may be taken as a general description.

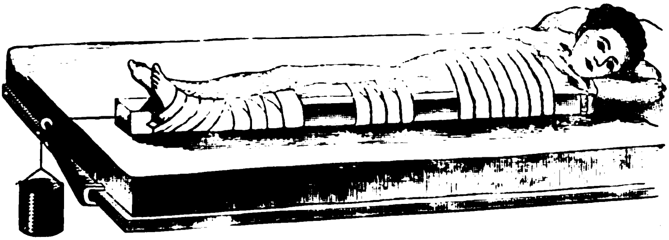

FIG. 120.—*Method of Attachment of Long Splint and Stirrup for Fractured Thigh.*

Application of the splint.

The foot of the bed must be raised on blocks, and all pillows be taken away from the head. The patient thus lying absolutely flat, one assistant grasps the thigh just above the knee and makes extension there, with internal

Importance of internal rotation.

rotation. Another assistant takes hold of the foot and ankle, and keeps the leg as much turned inwards as the thigh. These manipulations must be performed with the splint lying alongside, and as close as possible to the limb. The inward rotation is of great importance, and its neglect one of the commonest causes of bad position. It is very generally thought that the natural position of the lower extremity is to have the foot turned outwards, but this is an error. It is true that by education the foot has acquired a slight external twist during walking and standing, but if anyone with properly formed legs, be laid flat on the back, with the legs free, it will appear at once that the natural position of rest is to have the knees rolled slightly inwards and a very little flexed, with the feet in a position of slight equino-varus. This, then, the natural position, is the one which should be aimed at in placing a case of broken thigh on the long splint.

While the extension is being kept up, the splint must be adjusted and bandaged to the limb. If the length be right the small hole near the foot will just receive the outer malleolus, while the upper end just avoids pressure on the vessels and nerves at the top of the axilla.

In fastening this splint the direction of the bandage should always be from without inwards, or the opposite of the way enjoined by the orthodox. Unless this rule be observed, the tendency of the foot and leg to roll outwards will be increased. In bandaging the foot and ankle, the inner malleolus, the heel and the skin over the tendon Achillis must be carefully looked to, and extra padding applied wherever there seems a chance of soreness.

Fixing the heel.

The principal difficulty is to get a good grip of the heel, and yet not to bind it too tight. The best way is to take a turn or two round the ankle alone (not with the splint) and then to go round in a figure of 8, over the heel, inner ankle and side of the foot, passing the bandage each time into one of the deep notches cut in the end of the splint. The foot fastened, the leg with the stirrup is easily bandaged to the splint up to the knee, or over that joint and the end of the lower third of the thigh as seems best.

The support of the thigh.

The thigh itself may be treated in several ways. If the displacement be slight so that it can be overcome by simple extension, it will be sufficient to place a broad and short wooden splint along the back of the thigh, reaching from the gluteal fold to the popliteal space. The bandage should then be continued on round the thigh and the long and short splints, as high as the fork of the legs will allow, where it may stop, or be continued into a spica of the pelvis, although this is not often necessary.

But if the fracture be at all a severe one additional support is required for the thigh, and this may be given by adding top and inner straight splints to the back, and long outer ones. All four may then be bandaged together, or what is better, may be fastened by webbing straps.

A still better hold is sometimes got by cutting out a piece of "kettleholder" splinting, or felt or gutta-percha of a size and shape sufficient to encircle the front and inside of the thigh, and fastening this, with the back splint as before, to the outer splint by webbing straps. This upper splint should extend from the anterior iliac spine to the level of the top of the patella, and must be cut obliquely along its upper edge so as to be parallel with Poupart's ligament.

Attachment of splint to trunk.

As has been said, a spica is not often required, but whether it be used or no, the long splint must be fastened to the trunk as well as to the limb. This may be done with a broad bandage (flannel is best), passing round the thorax from the tenth to the second or third rib, or by broad belts, with several buckles, which are made for the purpose.

Weighting the stirrup.

It only now remains to fasten the weight to the stirrup, and to adjust the pulley at the end of the bed. The first is easily done by boring a hole in the wooden stirrup-end, passing a piece of stout blind cord through it, and securing by a knot. The most convenient weight to use is a shot tin. They are generally sold with the measure of the weight of shot which may be put in them, stamped outside. A common arrangement for the pulley can be seen in Figs. 119 or 120, but there are many patterns, all about equally good. No distinct rule can be given for the weight, but cases are rare which want more than 10 or less than 4 lbs., and the right amount will be the *least* that will produce extension. In all cases, however, some time will be required to exhaust the muscular spasm, perhaps even forty-eight hours, so that a weight should not be hastily condemned as insufficient. The weight and pulley should be frequently looked to, for the cord may jam, or yet more often, the long splint may get imbedded in the bedclothes or mattress, so that no ordinary weight would be of the least use. Lastly, and in view of the frequency with which this rule is forgotten, it may be repeated that the patient ought to lie as nearly as possible flat in bed with the head low for at least the first fortnight.

Other methods of treatment.

Only confusion would result from giving in corresponding detail the numerous and various other plans which have been advocated, and most of them are in no way calculated to succeed where the combined stirrup and long splint plan would fail. We will, however, shortly describe one or two methods which are found useful in cases out of the common run. The first of these is that of the double inclined plane (Fig. 121). This is particularly useful in fractures close by the knee, or where, as often happens in these fractures, there has been a T shaped splitting of the bone across and downwards between the condyles, into the knee joint, through the impact of the patella, as has been described by Mr. Willett.[*] In these cases, and in some others, no firm bandage or mechanical support can be borne by the injured knee, but extension can easily be made by laying the knee over the angle of a double inclined plane, and a good position is almost always readily thus attained. The angle should be the most obtuse which will secure the desired reduction, and the splint should always have a firm foot piece fixed at a right angle. Generally the limb lies so quietly upon the plane, that only very moderately firm bandaging is wanted (often a flannel roller suffices). In winter, one drawback to this plan is that it makes rather a cold bed.

Double inclined plane.

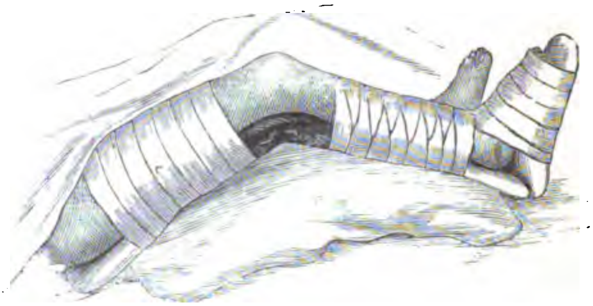

FIG. 121.—*Double Inclined Plane for Fractured Femur.*

Inclined plane with stirrup.

For fractures quite high up, a combination of the foregoing splint with a stirrup and weight fastened to the lower thigh fragment, has been advocated. In some awkward cases it might be successful, but it must always be mechanically difficult to arrange. The stirrup and weight alone, or without the long splint, but with the bed-foot raised, may no doubt sometimes be sufficient, but we doubt whether it is ever right to forego the great additional security of the splint, for the sake of a little more simplicity or a little trouble saved.

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[*] St. Bartholomew's Hospital Reports, Vol. X., p. 329, *et seq.*

The stirrup only.

On the other hand, not a few fractures, with but little deformity, can be set in very good position with no other arrangement fór extension or counter-extension, than that afforded by the long splint alone.

The long splint only.

The method of the perineal band has already been spoken of unfavourably; it only remains to be pointed out that even if it were a powerful means of counter-extension, still all the indications for its employment may be as well met by the method of raising the foot of the bed.

The perineal band.

A better splint than the simple Liston's will be often found in the long outside splint with a foot piece and back piece running up to the gluteal fold. This splint is made as in Fig. 122, but the outside splint varies in length according as to whether it is required for the thigh bone, or knee joint or leg. It requires to be carefully padded, and the pad should either be made thicker behind the ankle, to support the tendo Achillis and leave the point of heel unpressed upon, or the floor of the splint in that situation may be cut away as an alternative.

Macewen's splint.

This splint is generally called "Macewen's" splint, and has been largely used by that surgeon and others after osteotomy in the neighbourhood of the knee joint, etc., and in fractures of the thigh or leg.

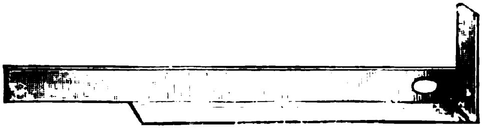

FIG. 122.—*Macewen's Splint.*

The limb, if fractured, should be bandaged and laid on the splint, then the foot should be adjusted against the foot piece, and the whole leg and thigh bandaged on, under extension and with slight internal rotation, the bandage running from without inwards. If required, strapping, plaster of Paris, etc, may be used.

In adults, the leverage of the fragments of this long bone is generally held to be too great to render treatment by

Plaster or silicate case in later stages.

fixing the limb in an immovable bandage, directly after the fracture has happened (such as in a plaster of Paris case) safe enough to be advisable.* But in almost all cases, in London, the practice is observed of allowing the later stages of consolidation, *i.e.*, after five or six weeks, to be completed while the patient gets about on crutches, with the limb firmly supported in a gum and chalk, silicate, or plaster of Paris splint.

The line of treatment to be observed in delayed union is precisely the same as that laid down in the case of the humerus. The condition is not very uncommon, but is rarer than in fractures of that bone.

In infants.

Fractures of the thigh in infants and children.

It was not very long ago held by some surgeons that in infants, fractures of the femur might in many cases be left alone to unite of themselves as best they would.† This negative treatment, however, is now, we believe, generally abandoned, and certainly any surgeon who has much to do with children, will see in his out-patient room, cases enough of over-looked fractures in which this treatment has been unwittingly carried out, and of the distorted limbs arising therefrom, to cause him to doubt greatly if it is ever advisable to follow it deliberately.

Why less severe.

Still, in several ways the fracture of this bone in infants may be treated much more simply than in the case of youths or adults. In the former it is almost certain that a complete snap across of the bone, with rupture of the periosteum hardly ever occurs, and though a mixed break and bend of the bone is common enough, a very slight support will be sufficient to keep it straight, and no shortening should result. A short back, or outside splint, secured with adhesive strapping, or a moulded felt splint, or plaster of Paris case, which may with advantage be painted with shellac varnish for cleanliness, should all do about equally well.

In children.

For children of a larger growth, the special points to be attended to are cleanliness, and the prevention of general restless movement of the whole body. For these reasons a very favourite way of putting up broken thighs in children (for example, of five years old) is to put long splints on both legs, passing the body bandage round both. Often no stirrup or counter-extension is wanted. A "Bryant's" splint, as described under "hip disease," does exceedingly well for this purpose, as does Sieveking's splint, figured in Maw's catalogue. In both of these there is a connection between the splints, and arrangements for extension if desired. Another very good way is to suspend the thigh *vertically* by a stirrup and weight attached to the leg, and passing over a pulley fixed above the middle of the bed. The advantages of this plan are that it is very easy to keep the child clean, for the leg (or both legs, if it seems best), may be thus slung safely up out of harm's way, and the perineum can easily be got at.

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* Mr. Cotterell however has recently advocated for adults the immediate application of a plaster case for the whole limb. This is to be put on while the patient is partly suspended from a modification of Sayre's tripod, and partly supports himself on the sound leg. Extension is made by a footpiece which can be raised or lowered by adjusting screws, and counter extension by chest and perineal bands attached by pulleys to the tripod. (*Vide* "Treatment of Common Injuries to Limbs," H. K. Lewis, 1885.)

† *Vide* "Holmes' Surgical Diseases of Children."

Splints for both legs.

Bryant's or Sieveking's splints.

Vertical stirrup and weight.

Up to eight years of age it will also generally be safe to put up the fracture immediately, in a plaster case, or a felt or other moulded splint, and even if it be at first put up with a long splint, three or four weeks at the outside will be long enough to keep the patient in bed.

Immediate encasing.

In infants or children there should be little or no shortening, but in grown up people it is extremely rare to get this result. Careful measurement will almost always show about half an inch, even in the best cases. But this is no real hindrance to perfect recovery; indeed, a full inch will not necessarily cause a limp, the back and pelvis accommodating themselves thereto.

Shortening to be expected.

It is coming to be more and more recognised that, generally speaking, the displacement of the fragments in fracture of the patella is due rather to distention of the knee-joint by blood, or by inflammatory products, than to tonic contraction of the quadriceps extensor muscle (although this may also bear a part in the deformity), and every year sees a larger number of successful cases reported, in which the joint has been aspirated, or tapped, as an immediate treatment for the accident. Indeed, a step further is now being taken, and surgeons are making vigorous efforts to attain to what has hitherto seemed to be beyond their grasp, namely, bony union in all cases, whether the fracture be produced by muscular action, or by direct violence. Not only have the edges of patellar fragments which have failed to unite, been cut down on, freshened, and wired together with success, but the same procedure has been carried out in recent cases of fracture, the advantages of

Fracture of the patella.

Recent plans of treatment.

thus securing close, and it is hoped, bony union, having been held to outweigh the risks of a free opening of the knee-joint.

Common causes of failure.

But whatever may be the future general treatment, the present belief is not seriously combated, that most fractures of the patella do well enough, and many very well indeed, without any such heroic measures. But the fracture is a very common one, and among the many cases there are a few in which the result is anything but satisfactory. Some of the reasons for this are not far to seek. In the first place there is no doubt that one great cause of failure is the effusion of blood and serum into the joint, and the inflammatory condition which is often set up. Not only are the fragments themselves thus widely separated, but the condition of the parts is one very ill adapted for the formation of firm bands of adhesion between them. Whatever, therefore, may be the particular way in which the fragments are to be fixed, no pains must be spared to keep the knee-joint quiet, and to promote absorption. Ice bags are extremely useful, as are evaporating lotions and the like. But the softening and disorganising action of intra-articular tension is very great, and in these fractures, if this reaches a high grade, and if external remedies do not reduce the effusion within about 48 hours, there can be little doubt that the wisest thing to do, is to aspirate the joint.* The place selected is generally on the inner side, a little above the middle of the patella, and the operation must be repeated if necessary.

Aspiration.

Simple aspiration, however, frequently fails to remove the whole of the blood which has been extravasated into the joint and become clotted. It is, therefore, often advisable thoroughly to wash out the joint, which can easily be done by having the aspirator fitted with a two-way cock, as in a stomach pump. In this way the joint can be alternately injected and emptied without withdrawing the cannula, and without any risk of the entry of air, a thing to be especially guarded against. Boracic acid or some other non-poisonous antiseptic lotion should be employed.

Washing out the joint.

A yet more common cause of failure is due to the efforts to approximate the fragments being made in a wrong manner. In an ordinary case, and provided the effusion be not very great, it is not difficult in several different ways to bring the fragments together, so that they are apparently in close apposition; but, in reality, unless this closeness has been produced with but little strain, there will be a buckling up of the parts, with the result that while the upper edges of the fragments are almost, or quite touching, the surfaces are elsewhere distinctly apart. In consequence of this, the bone unites at a very disadvantageous angle, and though perhaps the patient is discharged from the hospital with a good looking knee, any attempt to work will produce separation of the fragments, and the ligament when it once begins to yield, will get weaker and weaker, till the patient is condemned to a back-splint for life, or to the risks of a serious operation, or, it may be, to both.

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* For the use of aspirating apparatus see the Chapter on Minor Surgical Operations.

Risks of trying for very close apposition.

It will be better in such a case, as soon as it is found that the fragments will not come together except with considerable force, to be content with a moderate pull, which will allow the broken edges to be opposite and parallel to each other, though it may be at a little distance. The ligamentous band will be many times stronger than in the former case. Indeed it seems almost certain that the efficiency of a limb after fracture of the patella does not depend so much upon the nearness of the fragments, but is in direct relation to the strength of the ligamentous union.

Treatment of simple cases.

In the first place many cases will do very well if the limb be bandaged to a light back splint, and the foot and leg well raised. As the swelling goes down the fragments will come closer and closer, although they will never be quite together, and in two or three weeks a long moulded knee-splint may be put on, made carefully of felt or leather, and, for heavy patients, stiffened up the back with a piece of iron or steel, rivetted on (Fig. 123). (See also p. 133.)

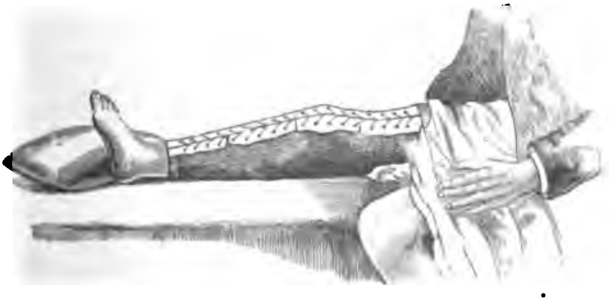

FIG. 123.—*Moulded Back Splint for Knee.*

The patient may now begin to get about on crutches, but must be very careful not to fall again. At the end of two months he should be able to walk with a stiff leg, with only the support of a stick, but the splint must be kept on for at least three months. It may then be left off at night, but no efforts should be made to flex the joint until six months have elapsed from the fracture, and even then the joint must be brought into work very gradually indeed.

We have been thus particular in describing the after treatment, because it is not uncommon, and is very disheartening, to find that patients whose patellæ have, to all appearance, united very well and firmly, have yielded to the temptation of leaving off the splint too soon, or of changing it for some more attractive but inefficient invention of an instrument maker, and in consequence have found, to their cost, that the tendinous union has begun to stretch ; and the fragments once on the move, may continue to separate, till a thin useless band, some three or four inches long, is all that remains of what should be as strong as the tendon of the gastrocnemius or quadriceps extensor.

Treatment by back splint.

Although many of these cases will do well with simply a back splint if the foot and leg are well raised, the general practice is to fashion some form of bandage and splint by which the fragments may be approximated, and certainly, so long as the "buckling up" we have spoken of is avoided, such contrivances are very often useful, and can hardly ever do harm—but in all cases, and whatever the apparatus used, the foot and leg *must* be raised. One common way is to lay the leg on a back splint (Fig. 124), hollowed out above and below for the thigh and leg.

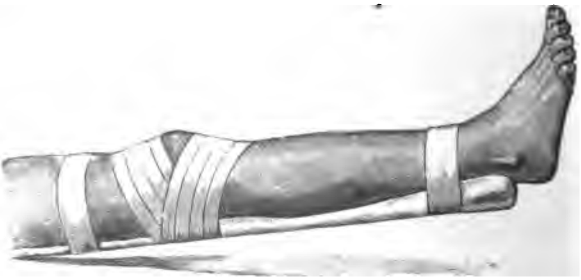

FIG. 124.—*Fracture of the Patella treated by a simple Back Splint and Strapping.*

The leg and splint should be raised, and the patient should be directed to sit up; it will then generally be found easy to bring down the upper fragment with strips of adhesive strapping, as shown in the figure. The lower piece of the patella must then be brought up as near to the upper one as can be managed in a similar fashion, the strips crossing each other at the sides.

Use of the studs.

Instead of strapping, a bandage may be used, and in this case it will be necessary to have a couple of studs or hooks in each side of the splint, about six inches apart, on either side of the middle line, to keep the turns of the bandage from shifting.

Of pegs.

Again, instead of the studs there may be pegs which can be screwed round, and the bandage thus be tightened like a violin string, when it requires it; and it will be found that all kinds of bandages will require readjusting, in one way or another, every few days.

Of gutta-percha caps.

Another good way of bringing the fragments together on the splint is to mould two gutta-percha caps to the fragments, of a horse-shoe shape, and then to approximate them instead of taking the pull directly on the fragments.

Of crescents of strapping.

Or a method which is still more secure from slipping is to adjust two stout broad and crescentic pieces of adhesive strapping to the leg and the thigh, below and above the fragments. The horns of these crescents are then prolonged by other strips, or by whipcord, so that they can be brought together by fastening these ends to studs in the splint, or, as recommended by the late Mr. Callender, to an arrangement of pulleys and weights, or indiarubber springs.

Of indiarubber bandages.

The indiarubber roller bandage, commonly known as "Esmarch's," if applied in the same manner as the ordinary bandage and fastened round the studs, will at first bring the fragments most forcibly together, but it cannot be depended on, and needs constant readjustment; the same remark applies to woven indiarubber bandages.

A more simple back splint.

Another, and simpler splint, is one shaped like the foregoing, but having a deep notch cut on either side of the knee. Strips of adhesive plaster are then passed above and below the two respective fragments alternately, and their ends fastened beneath the notch. The successive strips approach each other in the middle until they nearly, or quite, cover the joint. It will be seen that this method of treatment does not differ in any essentials from the foregoing, but it makes a more thorough compression of the joint.

Use of 8 bandage.

But even with a plain back splint, a figure of 8 bandage may easily be so applied to the limb that a considerable amount of approximation of the fragments may be produced, with the only drawback that it must be frequently looked to and adjusted.

Plaster case.

In cases where the effusion into the joint is small in quantity, or aspiration has been successfully carried out, the limb may be at once put up in a plaster of Paris case, extending from the upper part of the thigh nearly down to the ankle. The patient should be kept in bed for at least a week.

Bony union.

By any of the foregoing methods of treatment firm fibrous union is usually obtained, but surgeons are becoming more and more anxious to get firm bony union between the fragments. One or two methods of attempting this may here be mentioned.

The method of cutting down and wiring the fragments has already been alluded to, but other and simpler means often attain the same end, without the danger which attends every operation performed on tissues whose vitality has been impaired by injury.

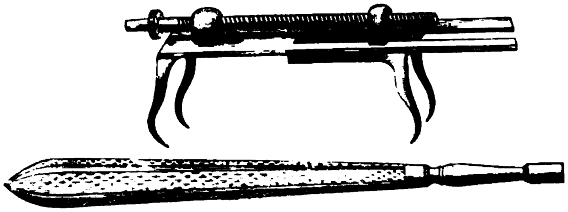

FIG. 125.—*Malgaigne's Hooks.*

Malgaigne's hooks.

Malgaigne's hooks, for example, will in certain cases be found perfectly efficient for this purpose, provided always that due regard be paid to antiseptics in their employment. The instrument itself must be sterilised by boiling, and one or two other points have to be especially attended to:—

Application.

(1) The leg and thigh should be firmly fixed on a patellar splint, and it is often advisable to use a Liston's long splint as well, so as to prevent any movement of the entire limb.

(2) After thorough cleansing of the knee, minute punctures should be made with a tenotome at the proper sites for the reception of the four hooks, the two smaller over the lower, the two larger over the upper fragment; and if the skin be drawn slightly upwards in making the upper

punctures, there will be less chance of a fold of skin being pinched up when the hooks are approximated.

(3) In screwing the hooks together care should be taken that there is no tilting of the fragments. If the fragments cannot be brought into apposition immediately, their complete approximation may be accomplished by an occasional turn of the screw in the few following days.

(4) Iodoform or boracic powder should be freely sprinkled over the sites of the punctures, and renewed daily. It is well also to have the limb freely exposed, and not covered by bed clothes.

It is often advisable to delay the insertion of the hooks for eight or ten days after the occurrence of the fracture, as by this time the tissues will have recovered from the immediate effects of the injury, and the subsidence of swelling allows of better and easier approximation of the fragments.

Steel pins.

Another method of approximating the fragments is by means of two stout steel pins, as recommended by Mayo Robson. Bonnet pins are suitable for the purpose, one being passed through the ligamentum patellæ, and the other through the quadriceps tendon, exactly at the point where these structures join the bone. The pins are then drawn closer together by a stout silk ligature passed around them and over the front of the knee in a figure of 8. The same precautions as to splinting and asepsis should be taken as in using Malgaigne's hooks.

Before resorting to either of these plans, it is necessary to remove all fluid from the joint by aspiration. The hooks or pins should be removed at the end of a month, and the limb should then be put up in plaster for two months more.

Fractures of the leg.

The legs, according to statistics, are the most subject of all limbs to be broken, and there are all sorts and kinds and degrees of injury which come under this heading. Putting aside, however, the different varieties of Pott's fracture, we shall find practically, that for the purposes of setting, simple fractures of the legs may be classed under two or three headings at the most. Moreover, from this point of view, we shall not have to consider whether one or both of the bones are involved, save that in bad fractures, both tibia and fibula are generally found to be gone, while in less severe cases, the fibula is more often broken by itself than the tibia

Broken legs, then, may be divided into—

The different degrees.

(1) *Slight cases*, requiring generally a moulded support only, such as a plaster of Paris, or a gum and chalk splint, which may be put on immediately, or after a very short time.

(2) *Moderately severe cases*, where for a fortnight or three weeks some regular splinting may be required, but which easily come into good position, and—

(3) *Severe*, and *very severe cases*, requiring the best skill and attention of the surgeon, for the replacement of the fragments, and their maintenance in proper position during the process of union.

All three kinds may be due to direct or indirect violence, and the seat of fracture may be in either the upper, middle, or lower third; but if in the upper, which is the rarest, it is generally due to a direct blow. Fractures in the lower third are the most frequent of all.

Slight fractures.

(1) *Slight fractures.* It is not at all unusual for a sudden twist, or a moderate degree of direct violence to produce a fracture of one (generally the fibula), or perhaps of both bones of the leg, with hardly any displacement, and often without complete disablement. Practically, these cases are not more severe than a sprain, and are recovered from at least as quickly. As there is little or no displacement, any measures which will secure absolute rest, will be sufficient for good recovery. The limb may be put up *at once* in a plaster of Paris case,* care being taken that the toes are not allowed to point. (*Vide infra.*) Or the limb may be allowed to remain unsplinted, but steadied between sand bags, or may be lightly bandaged to a Cline's splint, the limb lying on its outer side, and with some evaporating lotion over the seat of fracture. If the limb be not put up in the plaster of Paris immediately, there will be no choice but to wait for the swelling, which will develop in an hour or two, to go down, before the stiff case can be applied. No weight should be borne on the limb for about a month.

Moderately, severe fractures.

(2) *Moderately severe fractures.* By these we mean cases in which the injury is more severe than in the foregoing, but still ones which do not require the same rigid and careful restraint as in the following class. We have here a

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* Whenever the term "plaster of Paris" is used in this section, it must be taken to mean *any* of the materials for making stiff cases which the surgeon may prefer. And by a "Cline's" splint is meant the common wooden side splint for the foot and leg, with a hole cut out for the malleolus. A grave objection to this splint is that the foot piece is not at a right angle.

number of methods of treatment to choose from. The most common course, and one which generally does well enough, is to lay the limb on a Cline's splint (or some similar kind) on its outer side, with the knee flexed, and to bandage it there firmly. The leg thus splinted, may remain somewhat raised on a pillow, for a fortnight or three weeks, and it may then be put up in plaster of Paris.

Immediate treatment with plaster of Paris, etc.

But for such cases the practice is becoming more and more common, to immediately set and encase the limb in some form of moulded splint, adjusted however with more attention to position than was necessary in the slighter injuries just mentioned. This plan of treatment undoubtedly gives very good results in skilful hands, and effects a great economy of the beds in hospital accident wards. At the same time the responsibility of the surgeon is somewhat increased, because if the fracture be badly put up at first, it may happen that an opportunity for rectifying the position will never occur.

In all cases if this treatment be adopted, the encasing must be performed as soon as possible after the accident has happened, and before swelling comes on. Any of the materials out of which moulded splints are fashioned and which have been before described under that head, may be made to serve the purpose, but by most surgeons plaster of Paris will be the material chosen for the manufacture of the case, in consequence of the quickness with which it sets. This may be used in the form of a Bavarian splint, or the ordinary muslin bandages may be employed.

Recently the method of immediate splinting described by Mr. Croft (Med. Chir. Trans. vol. lxiv., 1881), or some modification of it, has come into very general use, as it has all the advantages of the Bavarian splint in the way of being able to be opened for inspection of the limb, and is yet much simpler. Each splint (for the leg two will be required) consists of two layers of house flannel. The inner layer, which is generally moistened with warm water, is applied to the limb, while the outer one is thoroughly soaked in plaster of Paris cream and put on over it. Both layers are then moulded to the limb while the surgeon holds it in position. *Muslin* bandages are then rolled on so as to thoroughly shape the splints and to bind them together. The turns of the bandage adhere to the plaster, but as the interval between the various splint pieces is spanned by the muslin only, this can be cut up for examination of the limb along the upper interval, while it serves as a hinge at the lower. In the case of fractures of the leg, the pattern for the pieces of flannel, as in the case of the Bavarian splint (see p. 138), can be got from the flattened out stocking of the patient. Inside and outside splints will here be required, and they must be cut of such a size that they will not meet in front or behind for about half-an-inch. This plan of splinting can be adopted in many different forms of injury, and to various parts of the body.

While the case is being applied, the limb must be most carefully held in position (preferably by the responsible surgeon), for upon this the whole success of the treatment will depend. After the case has set it will generally be advisable for the patient to remain in bed with the limb raised, for at least the first week; but in any event the period of confinement to bed will be much shorter than upon the old plan. Other fractures in this class are sometimes best treated by the back splint and swing cradle, to be presently described.

Severe fractures.

(3) *Severe, and very severe fractures.* By such terms are described all those in which the soft parts have been more damaged than in the preceding ones; in which the muscular spasm and the deformity are well marked and persistent; in which comminution is frequently present, and where in any case great care will be required to keep the fragments in position, and to restore the limb to its proper symmetry.

Compound fractures will be described more particularly later, but it may here be mentioned that no fracture becomes compound secondarily through sloughing of the skin so often as that of the leg, for the sharp tibial shin tries sorely the vitality of the skin which is stretched so tightly over it. Blebs also more frequently give trouble here than elsewhere.

In these severe cases there is always a tendency to an over-lapping and over-riding of the fragments. It is, therefore, necessary so to fix the limb by splinting, that extension as well as immobility is secured, and this must be done without strangulation.

Methods of splinting.

Many ways and many splints have been devised for setting these severe fractures uniformly. Only two methods will be described here in detail as being the most uniformly applicable in the majority of cases.

First method.

The first plan consists in putting the limb up upon a back splint and with side splints, and swinging the box thus formed, from a cradle. Fig. 126 represents a leg thus put up, and although it really is a simple method enough, still there are many small points which must be attended to.

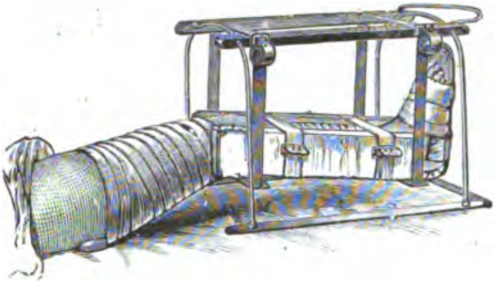

FIG. 126.—*Fractured Leg put up with Back and Side Splints and Swung.*

(The side splint is drawn short, so as to show the foot in position.)

The back splint.

1. *The Splint.* This is the kind known as "Neville's back splint," and consists of a plain piece of iron, with cross pieces for the leather bands, by which it is swung; it should be perforated along the sides to allow of the pad being sewn on, and bent up below to form a foot-piece; it has as well, lesser curves for the swell of the calf and the bend of the knee.

In choosing the splint for a given case, the important points to look to are—

(*a*) It should be fully broad enough, lest the bandage or side splints should too tightly compress the leg.

(*b*) The foot-piece should be bent up quite at right angles to the leg one.

(*c*) The length from the foot to the bend for the knee should correspond to that of the *sound* leg.

(*d*) The thigh-piece should be long enough to enable the bandage to take a firm hold of it.

(*e*) The bend at the knee must not be less than 160°.*

2. *The padding* of the back splint must be firm and even, and especially smooth about the heel, where the possibility of a sore being formed must be kept in mind.

The side splints.

3. *The side splints* must be well padded, and should be simple, straight, wooden ones, reaching from just above the knee to the edge of the foot-piece. At the foot there should be a short broad strap and buckle, which serves to fasten

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* These splints are always made too straight at the knee; fortunately they are easily bent.

the two together, the strap passing just below and round the foot-piece. (This strap is often omitted.)

The swing cradle.

4. *The swing cradle.*—All fractures bad enough to require careful back splinting are bad enough to be swung. Neglect of this is a frequent cause of bad position. The simplest plan is to pass leather straps through the slits in the cross piece of the splint, and sling it to the cradle, as shown in the figure.

The apparatus being ready, the limb must be fastened to the back splint; the whole difficulty of obtaining a good position, lies in the necessity for keeping up extension, and a slight amount of inward rotation while this fixation is effected. In difficult cases, or where there is much spasm or pain, an anæsthetic should be given, and its action pushed to complete flaccidity of the muscles.

Method of making extension.

One assistant should now grasp the limb about the knee, and rolling it slightly inwards, must be prepared to make counter-extension when required. The surgeon then taking hold of the foot and ankle, will generally be able, by making extension to get the limb into its proper position. Sometimes flexion of the knee or other manœuvres will be required, but we have never seen anything but harm come of the practice of dividing the tendon Achillis, as is sometimes recommended.

While the limb is thus extended, it must be settled on the splint, and fastened to it, and great care must be taken to keep the plantar surface of the heel well against the foot-piece, with the foot turned slightly inwards, and the hollow above the insertion of the tendon Achillis into the os calcis, properly supported. No point in the setting of the fracture is more important than this, as will be understood from what has been said before about the disaster of a sore heel. The readiest road to security in this respect is to have a store of small pads at hand, from which those can be chosen which will best support the hollow beneath the tendon, so that the point of the heel is free of, or only just touches, the splint.

This "fitting" of the foot and ankle finished, and a final look given to see that the upper bend of the splint corresponds to the knee, the limb, still held extended in position, is settled upon the rest of the splint. If a second assistant be at hand, to him may be entrusted the task of fastening the limb to the splint while the surgeon and the first one keep up the extension. But if, as often happens, one person only be available, the foot must be held by him with one hand while the first few turns of bandage or strapping are made with the other.

In any case the limb must be fastened to the splint very carefully, the heel must be kept down and the foot straight, while very possibly the skin has been bruised, and certainly all the parts are tender. In many cases one or two strips of adhesive strapping may be applied with great advantage round the foot and ankle, great care being taken that they do not strangulate the part, the risk of which is lessened if they are applied with a piece of lint between their surfaces and the skin. In the same way it is advisable to pass a piece of broad strapping round the thigh and the splint upon which it lies.

But whether strapping be used first or no, the foot and ankle must in every case be firmly bandaged to the splint, and then the upper part of the leg, the knee, and the lower third of the thigh must be fixed in the same way. No rule can be given as to the extent to which the bandage from the foot should be carried up the limb, but it is generally brought up to the vicinity of the fracture, but never over it. This done, in ordinary cases the limb will now be fixed in its proper position, and needs only to have the side splints adjusted and to be swung, as shown in the figure.

But very often some additional support is required, and further measures have to be adopted to maintain position. Thus one of the fragments may persistently rise, and project dangerously near the skin, or the foot may rotate outwards, defying the action of bandage or strapping; or the heel may be constantly coming away from the foot-piece; or, as very commonly happens, there may be a bowing outwards or inwards of the fragments, which simple extension does not overcome.

Directions for such conditions obviously cannot be given in any very precise form; nothing will remedy the pulling away of the heel from the foot-piece, except an entire replacement of the limb on the splint, nevertheless this will have to be done, for great discredit will accrue to the surgeon if the patient gets up from his bed with the foot pointed so that the heel can in no way reach the ground.

One of the ends of the broken tibia frequently presses upwards beneath the skin, partially or completely overriding the other. For this condition much may be done by judicious pressure with a pad, placed not immediately over, but near to the projecting end; in some cases raising the foot, in others bending the knee to remedy the deformity.

Gutta-percha caps, etc. These projections and lateral twists or rotations of the foot may often be very well corrected by caps, moulded to the leg and splints, of felt or gutta-percha, the latter being preferable as it takes a more exact shape. Thus round the foot and ankle, round the middle of the leg, or round the upper third of the leg and knee, a piece of gutta-percha sheeting can be moulded so as to clasp the parts. When fastened by one or two webbing straps they will hold very firmly.

Starching the bandage. It is generally worth while to rub some starch paste into the bandages which hold the limb to the splint; the operation takes only a minute or two, and the gain in neatness is great; moreover, it saves labour in the long run, for many patients, not children only, will pull their bandages about as soon as they can turn themselves in bed, but they will not disturb their folds so readily if these are stiff with starch.

Finally, all severe fractures of the leg will require constant supervision, especially during the first fortnight or three weeks. The limb should be looked at every day to see that the splint swings clear, that the heel is down, and that there is no complaint of soreness, while the surgeon must not hesitate to take the apparatus off and resettle it, if there be any indication that the position is not satisfactory.

Period of union. Fractures of both bones of the leg of ordinary severity require to be kept up about five weeks; in many, a shorter, in a few, a much longer time will have to elapse before they can be put up in a plaster of Paris or some other moulded case, when the patient may begin to go about on crutches.

The second method of splinting. The other good general plan of setting fractures of the legs which are too severe to admit of an immediate enclosure in a plaster splint, is to employ a splint of the pattern given on page 197, well padded, and of such proportions that the outside piece goes up to just above the brim of the pelvis, and the back piece to just past the middle of the popliteal space, the measurements being taken as for the sound leg, with the foot against the foot-piece. Reckoning for the padding the splints must be cut of the increasing widths which will allow the bandage to grip the foot and leg below the seat of fracture, and the knee and thigh above by passing round the limb and splint, but without any strangulation.

Pott's fracture. All the different fractures of the leg bones near the ankle joint, the majority of which are not difficult to manage, and indeed form the great bulk of our first division of broken legs, are not included under the heading of *Pott's fracture.* These as we have said may generally be put up in silicate or plaster of Paris, either immediately, or after a week or so, and give little trouble as to maintenance of position, or in any other way. It is unfortunate that these fractures should be so often confounded with the fracture described by Percival Pott from which he himself suffered; for this latter is one of the most serious in its deformity and difficulty in setting, which is known in surgery. Indeed, it may be doubted whether a true Pott's fracture is ever so perfectly recovered from, that the movements of the ankle are quite free, and no deformity is noticeable.

Nature of the injury.

The injury itself consists in a combined fracture and dislocation, occasioned by indirect violence. The fibula gives way (often through a slip on to the side of the foot) from 1½ to 3½ inches from the outer malleolus, and the inner malleolus is either separated from the tibial shaft, or the internal lateral ligament is torn across. In either case the foot is dislocated outwards, so that the sole is nearly vertical. Moreover, the tibia and fibula are almost always forcibly torn asunder to a greater or less extent, and from the widening of the front of the ankle thus caused, the tension of the skin is extreme. For this reason the deformity at the joint, and at the seat of fracture, must be rectified as soon as possible.

Treatment by plaster of Paris.

If the case be seen before much swelling has come on, no line of treatment is more satisfactory than a prompt envelopment in a plaster of Paris case, the foot being most carefully held in position the while. But this treatment is only possible when the patient is seen soon, and attended to quickly, and when a moderate amount of extension and manipulation will bring the limb into fair position. In many cases the swelling is very great, and comes on almost at once, while the foot, although it may be held in good position so long as extension is kept up, returns persistently to its external twist when this is relaxed, because the support of the fibula is destroyed.

With a back splint.

One way of meeting these conditions, which is very commonly practised, and which often gives good results, is to put up the fracture with a back splint and swing cradle exactly as has just been described for those higher up the leg, only giving still greater attention to the fixing of the foot to the splint, so as to get the sole flat against the foot-piece. Then, by means of the side splints, with extra small pads put in where they are needed, the tendency of the foot to twist outwards may be overcome.

With Dupuytren's splint.

A simple Cline's side splint will never succeed in keeping a limb thus fractured in good position; but the side splint devised by Dupuytren, if properly put on according to that surgeon's directions, is a method of setting so simple and efficient, that it should be used much oftener than it seems to be at present. The essential points to be noticed are shown in Fig. 127. The splint, a simple straight wooden one, is fastened to the leg, which should be laid on its inner side with the knee flexed. The pad, which is wedge-shaped, and about 2½ inches thick at its base, is so adjusted that the thick end is underneath the malleolus when the thin one lies beneath the knee. The limb is fastened to the splint, above and below, by a few turns of bandage. At the knee, these should only extend a little way down the leg, or the fibula will be pressed inwards; and below, *the foot alone* should be fastened to the splint. If the bandage be carried up over the malleolus, almost all the good effect of remedying the dislocation by forcible inversion is lost.

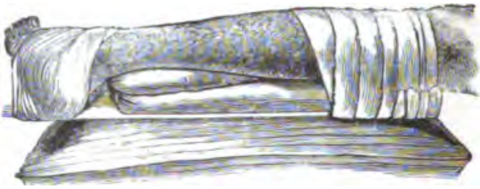

FIG. 127.—*Dupuytren's Splint for Pott's Fracture.*

Fractures of the bones of the foot.

No particular directions are required for fractures of the bones of the foot. They generally occur in crushes of the part, and the fracture is but part of the general injury. If other conditions allow of it, the best treatment in most cases is a plaster of Paris or silicate case.

Compound Fractures.

Compound fractures.

The points in which the treatment of compound fractures differs from the foregoing directions are points of surgery rather than of surgical handicraft. Questions such as whether a bad compound dislocation may rightly be saved, whether protruding ends of bone should be cut off, search made for wounded vessels, and so on, are not ones which can be discussed here. The additional details, therefore, of the management and manipulation of fractures, which are entailed on the surgeon by their being, or becoming compound, may be very briefly considered.

May heal like simple ones.

Fractures are, not infrequently, *clinically* simple, although there exists a skin and flesh wound communicating with the fracture; in these, if the limb be put up in the ordinary fashion, with some simple dressing on the wound, the repair will run its usual course without any additional trouble, the wound closing up straightway, either because the rent in the tissues has been so narrow that its sides have immediately come together, or because there has been an efficient and timely sealing up of the wound by effused blood and lymph, without any inflammatory process.

"Sealing" the wound.

Such a fracture has plainly never been really compound, and the classic rule of treatment was that when in a fractured limb there is a wound of only moderate size which *may* lead down to the bone, but from which there is little or no bleeding, this wound should not be opened up or disturbed in any way, but should be covered with some simple dressing and allowed to close of itself if it will. This "sealing" may be helped or imitated with a small piece of lint, soaked in collodion.

Treatment by some aseptic method.

A still better plan, however, is to dress the wound according to the Listerian or some other aseptic plan, with every precaution. A day or two will settle the question as to whether the fracture is going to convert itself into a truly simple one, or whether the wound will follow that course of aseptic, but slow, repair, which is characteristic of compound fractures treated on the Listerian plan.

But although a modified Listerism is here recommended in the cases of small wounds with doubtful communication with the fracture, for all fractures which are obviously or probably compound, there is no question but that the safest line of conduct is to treat them on the most uncompromising antiseptic principles.

This dressing in its details will be described in a following chapter, and the account will apply in every particular to the procedure in the case of fractures. The main special points are the difficulty of getting thorough drainage of the deeper parts, and the uncertainty which is often felt as to whether the fragments are in good position, under the necessarily voluminous folds of gauze or wool. In these cases it will often be found that some part of a splint which is essential for the support of the fracture, comes in the way of the wound or of the dressing over it; if so, the splint must there be interrupted, that is, the portion which is in the way must be removed, and iron rods carried across the interval, to connect the upper and lower remaining parts. These rods must be strongly riveted and bent outwards in a convenient curve. (See for example, Fig. 142.)

No cases are more tedious, or call for more close attention than those compound fractures, which run a septic course. A daily watch must be kept for bagging or burrowing of pus, for necrosis of the ends of the bones, or for some other of the host of complications which may at any time be sprung upon the surgeon. But, as we have said, the consideration of the surgery of these points must be looked for elsewhere.

CHAPTER XIV.

OF SPRAINS.

Sprains—definition.

A SPRAIN is a form of inflammation which may be either acute or chronic. It arises from a sudden twist or wrench, by which the capsule and ligaments of a joint, or the fascial structures in its neighbourhood have been stretched or torn.

Sprains vary infinitely in their severity, both in pain, and in the extent and duration of the disablement, but it may be taken that they are severe or slight, in direct relation to the extent of mechanical damage done to the fibrous tissues about the sprained articulation. We shall here chiefly consider *severe* sprains.

These always occur unexpectedly, and call for prompt treatment, for the time the joint will take to recover will depend greatly on the measures which are taken immediately after the injury.

Their immediate treatment. May be "aborted."

If a sprained joint be seen soon after the twist, there will have been no time for the development of inflammation. It is then in many cases possible to prevent this action coming on at all, by firm, even, compression, and absolute fixation of the joint. The principles of the treatment understood, the details may be varied. Thus for a badly sprained knee, the best course would be to put the patient to bed, to apply a Martin's bandage, or a wet roller, firmly, and then to fix the limb on a Nevill's or McIntyre's back splint, and to swing it from a cradle with an ice bag resting on the joint; so also, an ankle might be treated in somewhat the same way with a wet bandage and a back iron splint, but it would be even better to get a firm elastic compression by layers of cotton wool, and careful bandaging, and then to put up the joint straightway in plaster of Paris. The limb should be kept for a fortnight or three weeks in this stiff case, and will then require passive movement, shampooing, etc., as described below.

When the sprain runs its usual course.

The value of this "abortive" treatment of severe sprains cannot be overrated, but for it to succeed, the injury must be taken in hand at once. When pain, heat, redness, and swelling, the cardinal signs of inflammation, have once come on, a somewhat different line must be taken. Though it may be sometimes better to lay the joint simply on a pillow, it is still generally advisable that it should be supported, and if pressure can be borne, a wet roller or a Martin's bandage is often very serviceable. An ice bag, too, is a most salutary remedy, but it must be remembered that the joint is now inflamed and will bear only very gentle handling. Cold affusions, as from an irrigation apparatus, or a tap, or evaporating lotions may be applied. Sometimes, on the other hand, water as hot as can be borne,* or hot fomentations, or bran poultices are better, while if the inflammation be very severe, leeches (say half-a-dozen for a knee) are very useful.

The acute stage.

The chronic stage.

The duration of the acute stage of a sprain varies, and the condition only gradually passes off, leaving the joint weak and puffy, and susceptible to slight injuries, or apt to become painful with changes of the weather, etc. This condition of *chronic sprain* requires the most varied treatment in different cases, or in the same case at different times. At first it is often necessary to insist upon a splint, but this, if kept on too long, will lead to adhesions and stiffness. So too, the support of a bandage or strapping may be required for the atonic capillaries and veins, but the pressure causes wasting of the muscles if persevered with unduly.

In the later stages of the case all the surgeon's efforts should be directed to the getting the joint back again into working order. Cold and hot douches, shampooing and passive motion may be required, and if there be much thickening the joint may be strapped (*v.* Figs. 79, 80) with an iodine or mercurial plaster. But in cases of severe sprain the recovery is often very slow.

Adhesions.

In spite of all precautions, it will happen every now and again that joints which have been badly sprained (and the same holds good for dislocations), become fixed by internal or external adhesions, or by both, while the difficulty of movement is increased by muscular contraction. These cases give great employment to "bone setters," who are often very skilful in freeing the hampered movements. If a joint be free from heat and tenderness on pressure, no hesitation need be felt in forcibly breaking down the adhesions, either by taking the muscles of the limb by surprise, or, what is generally better, by free flexion and extension under an anæsthetic.

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* This is the remedy generally used by professional acrobats.

Pain not a bar to breaking down adhesions.

The presence of *subjective* signs of pain need also be no bar to this forcible passive motion, provided the *objective* signs of inflammation are absent, for most fixed joints become neuralgic. Even in chronic inflammations it is not always wise to keep the joint fixed, but the discrimination of the cases which should, from those which should not be so treated, often involves very nice points of surgery.

Use of the galvanic current.

In addition to the employment of douches and shampooing for the reduction of the thickening and puffiness which follow on a sprain, the effect of the constant (galvanic) current is so striking that it should be especially mentioned. The tendons get loose in their synovial sheaths, inflammatory exudations disappear, and even callous bone itself appears to be rapidly absorbed under this treatment. The current may be conveniently supplied by, say 10 to 20 Leclanché's cells, the negative electrode being formed of a plate of zinc covered with flannel, which can be so bent as to wrap round the joint.

Slight sprains.

Slight sprains do not generally require splinting, but they may often be cut short by very hot water, or by the firm pressure of a wet roller bandage, which will be found the best treatment for the casualty room, or by *massage* well applied. A Martin's bandage is also frequently used. When heat and swelling have come on, if a firm wet bandage can be borne, it is still the best treatment in most cases; if not, evaporating lotions, irrigation, or hot fomentations may be applied.

Walking off a sprain.

Lastly, in certain cases there can be no question but that forcible movement, with kneading of a sprained joint in its *acute* stage, and perseverance in its use, will sometimes cut the sprain short, that, in fact, it is true that a sprain can be *walked off.* The difficulty is to recognise the cases in which this method may safely be advised, so that the surgeon may be able to promise prompt recovery as the reward for present suffering, for the necessary manipulations are always painful. Experience alone will enable the surgeon to do this, and any rules would be misleading. One warning, however, may not be out of place, namely, that in the early treatment of twists of the knee joint, it is hardly possible to be too cautious, and in all cases where there is effusion, rest, and a back splint should be insisted on.

Internal sprain of the knee.

This will be a convenient place to mention a form of internal sprain of the knee, which appears to be due to some displacement of one of the semilunar cartilages, generally the inner one. The usual history of the injury is that the patient, during some sudden rotatory movement of the body, feels an acute pain in the knee, while the joint becomes incapable of full extension, though it can be flexed, and will allow of no weight being borne on it. Often the patient falls to the ground as if he had been shot. Soon, tenderness and signs of effusion into the joint come on, and these are generally out of all proportion to the very slight twist which has been the cause. Sometimes these symptoms disappear as quickly as they arose, after some slight movement; sometimes they obstinately remain as a chronic synovitis.

Symptoms.

If the joint be examined, it will be found that where the internal cartilage comes nearest to the surface (where, indeed, it is almost subcutaneous), there will be a spot of acute tenderness, and probably a little swelling. If this be found, the remedy is easy, and striking in its effect. Taking hold of the limb above the ankle with one hand (the patient lying or sitting) the knee should be strongly flexed, while the thumb of the other hand presses the cartilage inwards. Then, *without warning*, the limb should be jerked into extension, the pressure being kept up the while. In most cases, even at the first attempt, the cartilage will slip back into its place, and the patient will be able to extend the knee with great relief, but sometimes the manœuvre will have to be repeated two or three times.

Treatment.

After management.

The cause removed, the pain and effusion quickly disappear. It is wise, however, to rest the joint for a few days, and to wear a woven or elastic felt bandage, or a laced kneecap. Unfortunately, when once this derangement has happened, it is very apt to recur, and there are many who do not feel themselves safe to undertake such forms of exercise as running, jumping, or dancing, lest they should be suddenly disabled. Many also learn how to put their joints right again for themselves.

Much may be done by shampooing, the douche, and judicious support, to brace up the relaxed ligaments, and lessen the liability to the accident, acting on the same principles as in cases of chronic external sprain; but repeated dislocation is apt to lead to a chronic arthritis, and to distortion of the cartilage. This condition may call for an intra-articular operation for refixing the cartilage or removing it.

Of true loose cartilage.

The symptoms which arise when a true loose cartilage (usually originating as a pedunculated growth from a fringe of the synovial membrane) gets nipped between the joint surfaces, are almost identical with those we have described, except that there is not usually any limitation of extension. A patient who exhibits the signs of having a loose cartilage should be advised to seek advice immediately, if at any time the vagrant body should present itself so as to be felt from the outside. If this occurs, every effort should be made with strapping, etc., to prevent its slipping back into the depths of the joint until the performance of some planned operation for its removal can be considered.

If the fibro-cartilaginous body is felt loose underneath the skin and apparently lying away from its point of exit from the joint cavity, the best way is to spear it with a sharp tenaculum, and cut it out under strictly aseptic conditions; but if there be good reason to believe that there is a loose body in the joint, and it cannot be felt in the outlying parts, then it may very probably be right to open the joint and search for it, but this should not be done without due consideration, and except at a time when the joint is quiet.

SECTION IV.

OF WOUNDS, ULCERS, BURNS, ETC.

CHAPTER XV.

OF THE DRESSING OF ACCIDENTAL INCISED WOUNDS.

Of incised wounds—general principles.

IN the present chapter we propose to consider the general principles of dressing wounds, and the ways in which they are in practice dressed.

We shall first take those which may be properly called *cuts* or *incised wounds*, large or small, in which a quick healing is to be desired, and should generally be attainable, and we shall consider the rules as to their washing, closing, and draining, which are founded on the laws of cleanly surgery.

Some of the general ways of "dressing," that is, of covering or protecting these wounds will now therefore be described, while in the following chapter the methods will be considered in detail of a more scientific treatment of wounds.

In the succeeding chapters of the section, the management of bruised wounds, of special forms of wounds (as gun-shot wounds, etc.); and later still burns, ulcers, etc., will be discussed.

Conditions essential for healing.

For any wound to heal well, the following conditions must be fulfilled:—

(1) The wound must be cleansed, and kept clean.

(2) The divided tissues must be accurately readjusted and retained in position.

(3) The parts must be kept at rest.

(4) All effused fluids must be able to escape, and must be taken up on escaping. The primary blood effusion must be arrested completely, and the wound, in almost all cases, must be covered and protected by some dressing material.

1. *The cleansing of the wound.*

Cleansing the wound.

This will be necessary, even when it has been inflicted with a perfectly clean instrument, lest blood clots remain in it. For ordinary cases, the thoroughness with which the washing is performed is more important than the fluid which is employed. A lotion of carbolic acid (1 in 40 to 1 in 100), or of Condy's fluid, or of perchloride of mercury (1 part in 2000), are about the best to use.

Arrest of oozing.

If there be any suspicion that septic or poisonous matter has been introduced into the incision (*e.g.*, in a dissection wound), it should be thoroughly swabbed or syringed out with a 1 in 20 carbolic lotion, or one of chloride of zinc, in the proportion of 40 grains to the ounce, or of perchloride of mercury of the strength of about 1 part in 1000. The process of cleansing, of itself tends greatly to check the capillary oozing, and hæmorrhage from other sources must be thoroughly arrested before any attempt is made to close the wound.

It must be understood that the foregoing applies especially to the cases of incised wounds which occur in the casualty room practice of a hospital, or under similar conditions elsewhere. When wounds are inflicted, as in operations, by a surgeon, with deliberate intention they may, and should, be aseptic from the first, and not merely either fairly clean, or of various degrees of foulness. In such no efforts should be spared to maintain this aseptic condition throughout the healing, after some one of the plans described in the following chapter. But in casualty room practice, at least at the present time, this is hardly possible; on the other hand it is practically found that accidental wounds, inflicted upon healthy persons will often heal without suppuration after a thoroughly honest cleansing, without special antiseptic precautions, if only rest and drainage are provided for.

Removal of foreign bodies.

It goes without saying that all foreign bodies must be removed from accidental wounds, and in view of recent discoveries as to the connection of the earth-bacillus with tetanus, ordinary mud and earth must be got rid of entirely. If the earth has literally been ground into the wound, the best plan is to place the patient under an anæsthetic, and having washed away the more loosely adherent dirt, to scrub the wound with an ordinary nail brush.

Although the rule is broken every day, there is no question but that one of the greatest causes of failure of repair is the continuance of bleeding within a closed wound.

The actual bringing together of its sides does, no doubt, often effectually check further capillary bleeding, but it should not be trusted to do so, if it is in any way convenient to leave the wound open until this has quite stopped. The time to seize, if possible, for closure of the wound is when the lymph poured out from the lymphatic spaces is acquiring a plasticity or stickiness, which can be readily appreciated by the finger, and which gives to the wound surfaces a glazed appearance.

2. *The adjustment and closure of the wound.*

Adjustment of the sides of the wound; (a) of its deeper parts.

(A) *Of its deeper parts.* With the exception of the parts which are necessarily separated by the presence of drainage tubes, the adjustment and replacement of the divided tissues must be carried out throughout the whole extent of the wound, and if possible, as perfectly in its deeper parts as on the skin surface; for upon this the manner of healing, as well as the appearance when whole, will greatly depend. But the means at our disposal for keeping the deeper parts together after replacing them, are somewhat imperfect. In most cases the support and pressure afforded by pads and bandages put on outside the wound are trusted to keep the sides together, and if these will suffice, so much the better. But in many instances, and especially in plastic operations, it is necessary to fix the parts more securely, either by sutures, passed far below the surface (deep sutures), or by needles or hare-lip pins passed at a similar depth, or by what are known as "buried sutures," by means of which periosteum may be joined to periosteum, fascia to fascia (and finally, if necessary, skin to skin by an external stitch). These buried sutures are used especially in antiseptic surgery, and are designed to obviate the use of drainage tubes. They must be made of catgut or fine silk.

Deep sutures.

Deep Sutures. If the depths of the wound have to be kept together in this way, it must be because there is a tendency for the parts to separate. There will, therefore, be *tension* on the sutures, and unless some precautions are taken they will speedily cut out. All the contrivances which have been devised to prevent this have for their object that the sutures shall pull upon an area of skin at the margin of the wound, which is shielded in some way from the direct pressure of the wire or thread. For this purpose, the suture, which is passed through the wound at the depth desired, enters and emerges from the skin at a little distance from its edge, and is then fastened to a piece of quill or catheter, or passed through a perforated ivory

Their principle.

cylinder, or piece of sheet lead or zinc cut to the requisite size, or shaped as a stud or button. The illustration (Fig. 128) will show without further words the general principle of these fastenings, of which the details may be modified in many ways. The suture employed is almost always made of stout silver wire, but in special cases thick chromicised catgut may be used. The suture may be passed with a common needle, or with one of the numerous patterns of handled ones, or, in some cases, very conveniently with the tubular needle devised by Mr. T. Smith (Fig. 129) for operations about the palate or perineum.

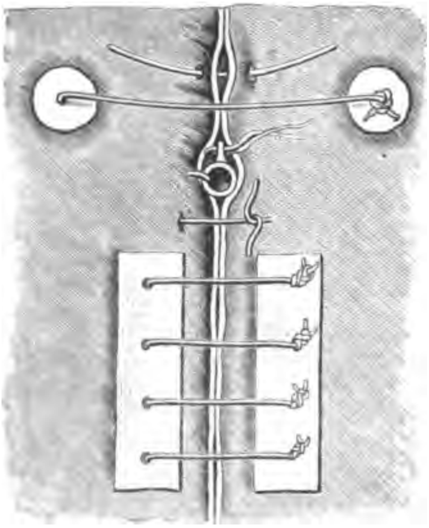

FIG. 128.—*Illustration of some forms of Deep and Superficial Suture, and of the Fastening of Drainage Tubes (after MacCormac). (The attachment of the thread to the Tube is imperfectly shown.)*

If short needles be used it will be convenient, and sometimes necessary, to use some kind of holder. For needles of the ordinary kinds a pair of Spencer Wells' forceps (Fig. 18) does very well, and forceps on the same principle with their jaws shielded with lead or copper are also used. Recently an ingenious holder, to be used with especial "sabre shaped" needles, but which will also do for most

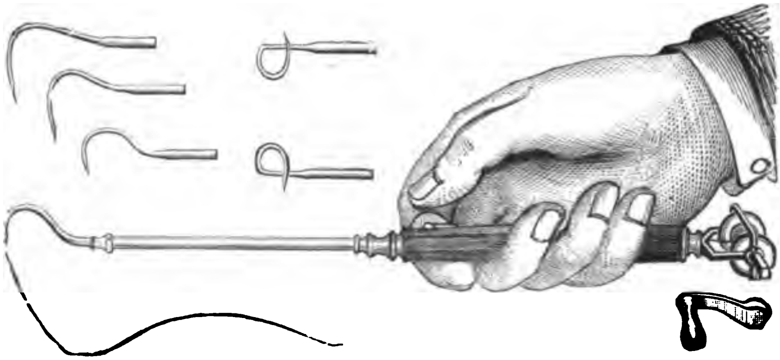

FIG. 129.—*Tubular Self-Feeding Needles.*

other ones, has been devised by Dr. Hagedorn, and is here figured. (Figs. 130, 131.)

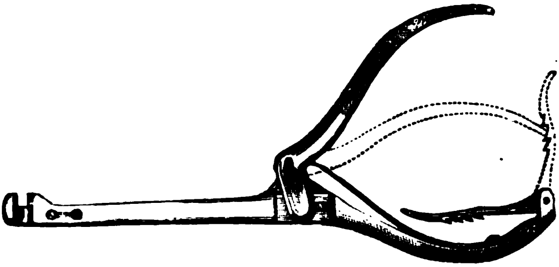

FIG. 130.—*Dr. Hagedorn's Needle Holder.*

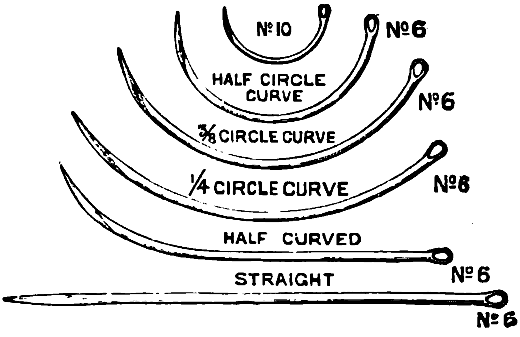

FIG. 131.—*Needles for Dr. Hagedorn's Needle Holder.*

Use of leaden shields and buttons,

For most of the cases where deep sutures are required, the best shield for practical use is a piece of sheet lead. It is sold in strips, ready perforated, but is best cut out with scissors to the shape required in each instance. A piece may be laid along each side of the wound, from a ¼in. to ½in. away from its edges; holes may then be bored in it to correspond to the number and distance apart of the sutures. The suture having been passed through the strips, the two ends are simply twisted together so as to close the depths of the wound. The twists should be to one side, and lying upon the metal strip, as shown in the figure.

Instead of using one long piece of shielding metal for each side of the wound, a rounded piece like a trouser button is very commonly cut out for each suture (also shown in Fig. 128), or pieces of lead, of this form, are to be had ready made with two studs on them, round which the wire may be twisted. These are convenient enough, but are in no way better, and in some respects not so good as the plan first described.

Another good plan is to secure the wire after it has been passed, whatever shield has been used, by closing a split shot (like those used in angling, but rather larger) over it.

Their removal. Deep sutures are easier to remove than to put in, for a pair of scissors placed between the skin and the shield on one side will be able to cut the wire short off there, and then it can be drawn out from the other side. No rules can here be given as to the time of their removal; this must be settled in each case at the surgeon's discretion, but in the great majority of cases their tenure is only possible for a day or two, much less that is, than in the case of superficial stitches.

Hare-lip pins. Hare-lip pins are steel pins which may be passed across the depth of a wound, entering the skin a little away from the edge on one side, and coming out at a corresponding distance on the other. Silk or worsted (the latter is to be preferred), is twisted over the protruding ends, so as to bring not only the deeper parts, but the skin surfaces into apposition. The point and head of the pin are then nipped off with a pair of cutting pliers, made for the purpose. Two little bits of lint should be put underneath the ends. No method brings all the parts of a wound better together than the use of hare-lip pins, but there are not many parts of the body where they can very conveniently be employed; their name tells when and where they are most commonly used. They would be resorted to much more frequently were it not for the fact that unless they are removed in from 36 to 48 hours, they will begin to cause ulceration, which will leave very obvious scars (this risk may be diminished by having them gilt or silvered). They must in any case be removed as early as possible, and this especially, when they connect the tender tissues of infants. They must not be *with*drawn, but drawn *through*, by seizing the end off which the point has been nipped, and making steady traction with rotation in the axis of the pin, but without working it from side to side. If possible, the silk or worsted threads, matted together with blood, should be left as a scab over the wound, after the pin has been taken out.

Must be removed early.

Superficial sutures.

(B) *Closure of the lips of the wound.* Superficial sutures are for the accurate adjustment of the divided skin surface, and of the tissues near it; in most wounds they are the only ones required. No strict rule can be laid down as to the depth at which they should be passed, but it is often convenient, as has been said before (p. 28), to put them deep enough to arrest bleeding from vessels in the cut edges of the wound.

Suture materials.

Wire, silvered, or of silver, silk, catgut, and occasionally horsehair, are the materials chiefly used for sutures, and of these, general preference must be given to silver wire. Silk and horsehair are used principally for wounds about the face, or in abdominal surgery, and catgut, which should always be chromicised, is especially useful in cases where it is desired that the parts shall not have to be disturbed for their removal, as in many antiseptic dressings. Catgut sutures, however, are not quite trustworthy; they stretch, and are apt to be absorbed too soon; silkworm gut is now largely used instead, and is not open to these objections.

Whatever be the thread used, the interrupted suture is almost the only one practically employed.* Each point is secured separately, by twisting, if it is of wire, or by tying in reef knots in other cases. Thin wire also may often be tied. In any case, the twist or knot should be at one side, and not over the line of the wound (Fig. 128). The actual skin surfaces should, if possible, be brought together exactly, but it is better that the edges should be a little everted than inverted. A little inversion is often overlooked at the time of adjustment, and the result is an unsightly depression.

Number of sutures, and time of removal.

The number of sutures must be just as many as will close the wound throughout; fewer will not do, and more are needless foreign bodies. So long as stitches are not doing harm, there is no limit to the time they may be kept in, but as soon as there is any tension, or area of inflammation around them, they are better away, lest they should be retaining discharges.

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* The continuous suture, however, is now getting to be more frequently used.

Silk sutures require only to be snipped and removed with forceps, but wire ones should always have the little hook which will be found at the end which is to be pulled through the wound, carefully straightened out or cut off. No more needless pain can well be inflicted than that caused by neglect of this small precaution.

Closure by strapping.

Adhesive strapping may be used to relieve tension which would otherwise be borne by the sutures alone, or may be the sole means employed to close a wound. In either case, care must be taken to avoid puckering, and the best way to do this is by cutting the strips as shown in Fig. 79 and described on page 118. If the adjustment be carefully made, there is no better way of closing a wound. The widely diffused support of the plaster is extremely useful, but no wound, except very small and clean cuts, should ever be completely closed over with strapping; a drop of pus thus shut in may work very great mischief.

Collodion.

The use of serréfines, or other mechanical contrivances for the closure of wounds, is now practically abandoned, and there only remains to be mentioned a mode of closing small wounds, especially about the face, by collodion; the ordinary, or the flexible kind may be painted over the wound or applied upon a piece of lint, and by its contraction a close apposition may frequently be attained.

Rest.—Its importance.

3. *Arrangements for rest, i.e.*, for retaining the wound surfaces in apposition. It is not necessary to enlarge on the importance of this point. It will be understood that a wound can hardly heal unless it be kept at rest, and also that the means of securing this rest must vary with every case.

In the case of wounds of the extremities, the end desired can generally be attained by splints, interrupted if necessary, and slings and other contrivances may be brought into use, the limb being placed in the position which causes least tension on the edges of the wound.

Moulded splints are especially useful in fixing the parts about a wound, and this necessity for rest must always be kept in mind in considering the firmness with which a wounded part should be bandaged.

Drainage of the wound.

4. *Arrangements for the ready escape and absorption of all exuded fluids, and for the covering and protection of the wound.* The means to be adopted to secure the fulfilment of these conditions, include the different ways in which wounds may be drained, and the several "dressings" that may be put on them.

There will be in all cases some fluid exudation, whether a wound has been closed before the bleeding has stopped or no, and provision must be made for its escape, except in wounds which are at once small and perfectly healthy.

Kinds of drainage materials.

The materials generally used for drainage are, indiarubber tubing of different sizes, flexible tubes of coiled up wire, tubes of decalcified bone, and wisps of horsehair, or catgut; but almost anything of the nature of a tube or a thread, if it be in itself unirritating, may be placed in a wound to facilitate the escape of the discharges.

Drainage must be from the bottom.

As the whole object of a drain is to prevent fluid remaining within a wound, no exception can be made to the rule that all surgical cavities are to be drained *from the bottom.* The place of exit for the drain should therefore be the most dependent part of the wound, unless, as is often advisable, a separate aperture is made for the tube alone. Often, too, it is necessary to pass the drain right across the cavity, either by making it enter the wound at one end and leave it at the other, as may be done in amputations of the limbs, or of the breast; or by making apertures, and counter apertures, as in some methods of paracentesis thoracis (*q.v.*).

Horsehair, silk, or catgut drains.

If horsehair be used as a drain (and for wounds with but little discharge it is very useful, especially in sinuses, where it can be laid right along), some 20 or 30 hairs must be cut of equal length and tied together at each end. Catgut, silk, thread, or strips of gutta-percha tissue or of oiled silk, flat or twisted up, are all in constant use for drains. Rigid silver tubes, retained by an expanding spring have been devised, but have no extensive use; indeed it would be easy to make a long list of contrivances for drainage which have been brought forward and abandoned within the last few years.

Drainage tubes—the different kinds.

Coming to drainage *tubes* proper, glass ones have been almost exclusively used in abdominal surgery, as for the drainage of the peritoneum in ovariotomy; the advantages and drawbacks of the material can easily be understood.

One great disadvantage of coiled wire drainage tubes is that the granulations are apt to sprout between the interstices of the coils. Tubes made from small bones, decalcified by hydrochloric acid, and thus rendered absorbable, have lately been introduced by Professor Neuber, and are now extensively used in this country, and decalcified chicken bones have been employed by Macewen. They are especially intended for wounds treated on the Listerian plan, for it is intended that they shall be gradually absorbed in the wound. Up to the present time, experience goes to show that they often behave as is desired, but that the rate of their absorption is capricious, and is apt to be sometimes extremely delayed, and sometimes too quick.

Rubber tubing.

But the drainage material which will probably be for long in most general use, is *indiarubber* tubing, of which special kinds are made, of various sizes, and perforated at frequent intervals.

The points to be kept in mind as to the drainage of a wound by indiarubber tubing are, (1) the requisite size of the tube, (2) the mode of introducing it, (3) the keeping it in its place, (4) the occasions of its withdrawal for cleansing or shortening; and, finally, the time when it may be permanently discarded.

Size.

All drains are foreign bodies, and, *ipso facto*, hurtful. The tube, therefore, must be as small as will freely carry off the discharges.

Introduction.

No general rule can be laid down as to the mode of insertion of the tube. It may be put in before or after the wound is sutured, and a probe or director, or the special instrument devised by Sir Joseph Lister may be used. Forceps of the ordinary kind are objectionable, as they disturb the tissues.

Retention.

The tube is apt to accidentally slip in or out; this may be prevented by threading a common needle with silk or thread, and passing it through the tube wall (see Fig. 128), from ¼ to ½ an inch from its end. The ends of the silk may be left about two inches long, and fixed to the skin surface by a little bit of strapping. A safety pin may be put across the aperture of the tube, or some form of shield may be employed.

Withdrawal or shortening.

For the same reason that the tube should be as small as will be efficient, it should be removed as soon as it is safe to do so; and if it cannot be withdrawn altogether, it should be shortened up from day to day. But it is impossible to lay down any strict rules; in such a case as an amputation of a limb, or of a breast, healing by first intention, the tube may be removed on the second or third day, while in a chronic abscess, the tube may have to be left in for months; but in any case it is a safe rule to follow, that every time the dressing of the wound is changed, the tube must be taken out and syringed through with carbolic lotion.

When a tube may be dispensed with.

In cases of accidental wounds a drainage tube is usually required, but in many operations it is possible to do without one, in those, for example, where the incisions have passed through healthy structures. Here, if all bleeding be stopped before the wound is closed, and firm, equable pressure be applied, not only by the dressings, but also during the time that they are being put on, it will be found that healing will take place perfectly. There are many advantages in being able to dispense with a drainage tube, and amongst them by no means the least, both as regards disturbance of the wound and the comfort of the patient, is the greatly lessened need for changing the dressings. A tube is in itself irritating and affords a space into which leakage of serum must, and will, take place. Its presence may also lead to the formation of a troublesome sinus which materially delays the healing.

In cases where it is not thought desirable to close the wound entirely, one angle may be left open, so that any discharge may find a ready means of escape.

The covering of wounds, or "dressing" proper.

Although we are using the term "the dressing of wounds" in its larger meaning, to include all the details of its management, "surgical dressing" is a phrase generally used in a more contracted sense, to express the materials and medicaments which are put over a wound to cover and protect it, and to forward its healing. These may be conveniently divided into *dry*, *watery*, and *oily* dressings.

The main divisions of dressing materials.

The medications used may have for their purpose the prevention of decomposition, or the maintenance of simple cleanliness, or some stimulation of the wound; or a cool, a warm, or a moist atmosphere may be desired, or simple greasiness of the surface. But whatever be the nature of the dressing, it must before all fulfil the indications of cleanliness, and absorption of the discharges.

Modern simplicity.

Just as in former times it was believed that a simple fracture could not unite, unless healing salves of various kinds were applied to the skin, so even up to the present day, many seem to find it difficult to remember, that the nature of wounds is to heal, and that nothing applied to a wound can of itself heal it, though many things can be done to retard or prevent the healing process. In fact, the results now desired, are almost absolutely negative ones, such as the avoidance of movement, of irritation, or of tension, the removal of discharges, and the like.

But, while it is every day more recognised that the best way to dress a wound is to "severely let it alone;" in most cases some kind of application will be required, and the nature of the dressing does in many cases affect the course of the repair. Thus granulations will often become large and flabby under carbolic oil, and again, small and prone to bleed, under the use of chloride of zinc. A choice, therefore, has to be exercised, but experience alone will give the power of judicious selection.

Classification of dressings.

For the purposes of description, some classification of wound dressings must be adopted, and the following may probably be found convenient. We shall first divide them into dry, watery, and oily dressings, and then arrange the drugs and materials used under each head, according as to whether they are chosen because they are non-irritant, anodyne, antiseptic or stimulating.

Dry dressings.
1. By scabbing.

Simple scabbing. In a healthy atmosphere, even large amputation wounds will heal well if they are simply exposed to the air with no dressing whatever upon them. The effused blood and lymph form a crust, under which repair progresses, and if care be taken that no discharges are retained, the results of this almost absolute neglect of the wound are very good, especially in the country, as in cottage hospitals. But the method is not generally adopted, because of various inconveniences, of which the chief is, that no support is afforded to the limb generally, or to the deeper parts of the wound in particular, where the pressure of a bandage or pad is often very desirable.

2. By dry absorbent pads.

But this objection does not apply to the dressing by dry absorbent pads, a plan especially advocated by Professor Gamgee. The principles of this method are "dry and infrequent dressings, immobility and pressure."*

A great many different materials have been used for pads in this form of dressing, and, sometimes one, sometimes another, will answer best. What is wanted is a proper firmness, combined with elasticity, so that a moderate restraining pressure is kept on the wound. At the same time the material must be *absorbent*, to provide for the infrequency of dressing. Pads of lint, of salicylic wool, or cushions of the one lined with the other, marine tow, or lint, or oakum, boracic lint, tenax, sawdust bags, wood wool, carbolic gauze, and sponges, have been used, and many more. Of all these, the best for general use, seems to be the salicylic wool, made into a pad, and covered with gauze, but sometimes sponges will be found very useful; thus they may be applied to either side of an amputation wound, or placed in the axilla after amputation of the breast. A wound dressed on this plan must have its edges, and if necessary its deeper parts, adjusted with the appropriate sutures, and provision must be made for its drainage; secondly, the mechanical fixation of the neighbouring parts should be secured by moulded splints, or plaster of Paris bandages, or similar contrivances for the fulfilment of the indication of immobility; and thirdly, the parts immediately concerned in the wound must be covered, and lightly but firmly pressed upon by the absorbent pads, secured by bandages.

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* "The Trinity of Healing." Gamgee. *Lancet*, February, 1876, p. 887. See also Professor Gamgee's larger work on "The Healing of Wounds."

If the discharges from a wound thus treated are only moderate in amount, there will be no necessity to change the dressings for some days, and no method gives better results in the case of large healthy wounds.

Other dry dressings. Other forms of dry dressings there are which have proved valuable in the hands of those who advocate them, such as the dry earth plan, etc., and layers of dry boracic lint, fastened on with a carbolized gauze bandage, will often be found to give as good results as any of the most complex methods.

A dry anodyne dressing of opium powder and powdered bark in equal quantities is sometimes used in cases of painful cancerous ulceration. It may be dusted on the parts, and covered over with layers of boracic lint or tenax.

Iodoform. *Iodoform* in powder, besides being largely used in recent developments of antiseptic dressings (*vide* Chap. xvi.) and for venereal and syphilitic sores (*q.v.*), is now often employed as a dressing to incised wounds, being freely dusted on the part, underneath whatever other dressing may be chosen. A small dredger, such as is used for Keating's insect powder, or a pepper castor, is a convenient receptacle for it. It may also be used as an ointment mixed with vaseline, or as an ethereal solution, which, painted on, leaves it as a thin pellicle, upon the evaporation of the ether.

Wet dressings. *Wet dressings.* This class of application is a very large one, and comprehends all lotions, tinctures, hot or cold compresses, and poultices; every dressing in short, by means of which the surface of wounds may be kept moist.

In the great majority of cases, the moistening fluid is applied by soaking pads or strips of lint in it.

Water dressing.

Before all other wet applications, must be placed the common "water dressing." This simply consists in the covering of the wound with a few layers of lint moistened with water, or with a weak watery lotion, renewing the moisture when necessary. Very often it will be found that wounds heal more kindly under this treatment than under any other. In order to check the too rapid drying of the lint, a piece of oiled silk, or gutta-percha tissue, may be put over it, but this must be smaller all round than the lint, or the dressing will be changed from a cool and moist, into a warm and steamy one, in fact into a poultice.

Watery lotions.

Watery lotions are generally applied in the same way as the simple water dressing, but they may also be useful for irrigation or immersion.

The following are examples of the lotions which are used in the dressing of ordinary wounds. Some are simply non-irritant, others are stimulant, or antiseptic, or anodyne, but no regular gradation is possible. The strengths of the preparations are given in the formulary at the end of the book.

LOTIONS OF

Permanganate of Potash (Condy's Fluid)
Carbolic Acid
Perchloride of Mercury
Boracic Acid
Sub-Acetate of Lead (Goulard Water)
Sulphate of Zinc
Chlorate of Potash
Alum
Nitrate of Silver
Chloride of Zinc
Chlorinated Soda
Liq. Chlor.
Iodine
Liq. Carbonis Detergens
Sanitas
Terebene
Chloralum
Sub-Acetate of Lead with Opium
Belladonna

It will, of course, be understood that many of these lotions may be used in several different strengths, and for other purposes than for dressing incised wounds.

Irrigation.

Irrigation is a form of wet dressing which is sometimes used for clean wounds, especially when they are near joints, but it is much more often adopted for foul or sloughing ulcers, under which head it is again mentioned. Its great drawback is the risk to the patient of catching cold from the exposure, which can hardly be avoided.

To set up an irrigation apparatus, all that is required is an arrangement by which a constant drip of water, or of some lotion, can be made to fall upon the wound, as shown in Fig. 132. This may be done by suspending a vessel over the wound, properly fitted with a tap and india-rubber

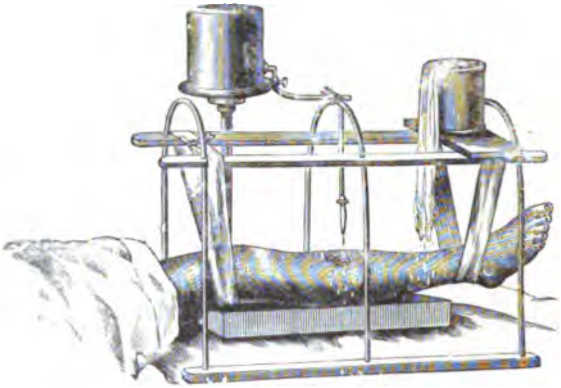

FIG. 132.—*Methods of Irrigation.*

tubing, or the tube may be allowed to act as a syphon. In either case the difficulty is to get the drip to be sufficiently slow, and quite as good a plan, is the simpler one of hanging one or two strips of lint from a vessel supported above the wound. The fluid is evenly distributed, drop by drop, by the strips which act as syphons by the capillary attraction of their fibres (see Fig. 132). It will be necessary to put some pan or basin beneath the wounded part, and the bed must be kept dry with water-proofing; but there is always some slopping, and the patient had better lie in blankets.

Immersion. Plain water, Condy, carbolic, boracic, or iodine lotions, are the fluids most frequently used for irrigation, and although, if this treatment be continued for many days, the granulations are apt to become sodden, no dressing will more efficiently clean a wound; immersion of the wounded part in a bath of warm carbolic, or Condy, for many hours, is often also extremely beneficial.

Poultices. A poultice is now rarely seen in the surgical wards of a hospital, or in any place where the practices of cleanly surgery are observed; and if any attempt be made to maintain a truly aseptic standard in the methods adopted for the treatment of wounds, the use of a fermentable decomposable mass of bread crumb or crushed linseed, which constitutes the old-fashioned poultice, becomes impossible.

In the medical wards this kind of application of warmth and moisture is not open to the same objection, and among the out-patients in the treatment of the sores and whitlows and similar casualties of daily life, it is hardly likely that they will ever really go out of use. Crushed linseed meal, or stale bread crumbs, are the chief materials used, while the addition of an eighth part of charcoal powder forms the ordinary charcoal poultice, a very common application to fœtid wounds.*

Compresses of lint or spongio-piline.

The indications which call for a poultice, may be met, though perhaps not quite so well, by water dressing, *completely* covered with gutta-percha tissue, or oiled silk, or by spongio-piline, cut to the requisite shape, and soaked in either hot or cold water. To such an application the term "a compress" is applied.

Tinctures.

Certain alcoholic tinctures, generally freely diluted, are in common use as wet dressings. Of these, Friar's Balsam (Tinctura Benzoinæ Co.) should be mentioned as an admirable stimulant for wounds which are slow to heal. It is applied by soaking pads, or strips of lint, in the tincture, and is probably the best of the preparations of aromatic gum resins.

Whether the tincture of arnica has any especially beneficial action on bruises, contused wounds, and the like, beyond that of the spirit it contains, is doubted by many, yet it would be singular if so widespread a belief as that which prevails as to its virtues, were quite groundless. It is, however, certain that even very weak lotions made with this tincture will sometimes create quite an extraordinary amount of irritation, which may run on into true erysipelas; and the drug certainly possesses no merits to compensate for the drawbacks of such a risk.

Tincture of iodine, freely diluted, is often used as an antiseptic and stimulant application; it makes an admirable irrigating fluid, especially for foul wounds.

Oily dressings.

Coming now to the *oily dressings and ointments;* olive oil, pure and simple, would be largely used, on account of its absolutely non-irritant qualities, were it not so apt to become rancid; but when carbolic acid is added to it, it forms an application to wounds which is universally appreciated. Carbolised oil usually contains one part of the acid to 40 of oil, but other proportions may be found more useful in

Carbolic oil.

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* Charcoal *in powder*, is perhaps the most powerful disinfectant and deodoriser known; used as a poultice this property is greatly impaired. The methods of making poultices and fomentations, are explained later.

special cases. In the proportion of 1 in 15 or 1 in 20, it lowers local sensibility without having the escharotic properties of the pure acid or its stronger solutions. It is generally used by soaking pads or strips of lint in it. The oil of eucalyptus, thymol, or terebene may also be mixed with olive oil, and used in precisely the same way as the carbolised oil. They are all good dressings, although they have not yet been shown to be in any way superior to carbolic oil: any of them, the eucalyptus oil especially, may be used when carbolic acid is contra-indicated.

Eucalyptus oil.

All these dressings, if continued for long, are apt to make the granulations large and flabby; they should then be changed for some astringent lotion, such as a solution of sulphate or chloride of zinc.

Castor oil

Castor oil is rarely applied externally, except in injuries to the eye, where its viscidity and blandness make it very useful.

Ointments.

Ointments of various kinds are largely employed as dressings for wounds, especially in the later stages of their healing. Some are chosen for this purpose because they are non-irritant, as the ung. simplex, or ung. spermaceti, or because they have more or less stimulant properties, as the ung. zinci oxydi., or the ung. hydrarg. nitroxydi, diluted with an equal quantity of vaseline or lard. For others the reader is referred to the text books on therapeutics.

Vaseline.

Vaseline, though in no sense an oily material, may conveniently be classed with them. It is a clean and bland dressing, and serves also as a basis to which various drugs may be added, so that they can be applied as ointments. Some of these will be mentioned under the headings of the dressings of ulcers, bed sores, syphilitic sores, etc.

Speaking generally, ointments are most conveniently applied by spreading them on lint or on old rags.

CHAPTER XVI.

OF THE ANTISEPTIC DRESSINGS OF WOUNDS, AND THE ASEPTIC PRECAUTIONS OF OPERATIVE SURGERY.

Since this chapter was written it has been already necessary to almost wholly re-write it once for the Second Edition. It is now necessary to recognise the still further recent developments of the practice of treating by aseptic or antiseptic methods all wounds inflicted by surgeons. The alterations seem to concern details rather than principles, and more particularly to concern the question as to whether absolute "Listerism" be indeed the best way of destroying, or inhibiting the development of bacteria in a wound.

Moreover, it seems to be the growing opinion, that in order to prevent septic changes and their absorption, it is not so essential to render the *contact* of germ elements with living tissues impossible, or to destroy them if they are already present, as it has been hitherto believed to be; and it has further been shown to be much more difficult to effect that destruction in healthy living tissues, than in artificial cultivation fluids.

But, on the other hand, the opinion is fast gaining ground that a wound will run a perfectly aseptic course, if bacterian development be *inhibited* only.

The practical conclusion seems to be that the elaborate precautions which have been taken to secure this complete protection of wounds from the presence of germs, or their immediate destruction, if there, are very difficult to effect, and are also unnecessary, provided that the wounded tissues be maintained in such a condition that their development is made impossible.

The antagonism again, that healthy living tissues present to the energy and action of bacteria is more fully recognised.

Thus, while the value of antiseptic dressings in preventing septic absorption is as much allowed as ever, the opinion is gaining ground that these results may be obtained in more simple ways than heretofore, and faith is again being more placed in the capacity of healthy tissues in a wound to heal aseptically and to be unaffected by germ elements in their neighbourhood, provided that they are so treated as to be kept in health throughout.

This tendency to simplicity has especially shown itself in the abandonment of the spray, and the substitution of irrigation, either throughout the operation, or towards its termination, the antiseptic fluids used being carbolic acid (1 in 40), or perchloride of mercury (1 in 1000). In all other details of immersion of instruments, sponges, etc., the proceedings are the same as in a strict Listerian dressing, and the wound is dressed with carbolic or corrosive sublimate gauze, salicylic wool, or with iodoform freely sprinkled over the wound, and then covered with the gauze or wool; the rules for drainage being according to ordinary surgical principles.

The Antiseptic Method of Lister.

Listerian dressings.

Descriptions of the germ theory of disease, and the other arguments by which Professor Lister seeks to place on a scientific basis the proceedings which have for their object absolute purity of the surfaces of wounds, and of everything that may come in contact therewith, may readily be found by all who desire to inform themselves on these points,* and we have here only to state, as shortly as may be, how the necessary details of the Listerian method should be carried out.

At first sight these may seem very numerous, minute, and difficult to remember, but as a fact if it be conceded that the surgeon or dresser himself believes in the reasonableness and necessity of all the precautions, these details will be carried out as matters of routine, without fear of any being forgotten.

Many of the points which are very important or essential to the success of the Listerian dressing, are yet common to it and to other forms of cleanly surgery, and as such, are described under the head of the general treatment of wounds. Drainage, for example, and the employment of animal ligatures, are essential points in several methods of dressing wounds, other than the Listerian plan, although the recognition of their importance is largely due to Professor Lister's advocacy.

Perfect asepsis.

A wound may be considered to have run a perfectly aseptic course, when there is throughout its healing, no fever, *and no suppuration.* It is desired to secure this by the Listerian dressing, and all cases in which, after antiseptic precautions have been taken, traumatic fever, or profuse suppuration, or both, develop, must be regarded as failures, however well the patient may recover. On the other hand, wounds both large and deep will often under good hygienic conditions, heal without suppuration, indeed perfectly aseptically, although these special precautions have not been taken.

The necessary precautions.

It is obvious that the Listerian method, when it is applied to operation wounds, starts under far more favourable conditions than in the case of accidental injuries; but in both instances the same end is desired, and much the same means are taken to attain it.

These means are, all of them, taken so as to ensure absolute purity, and the absence of germ elements, and they may be considered under the following heads:—purity (1) of the air; (2) of the wound and of the parts adjoining; (3) of all instruments, bandages, and other things which can come into contact with the wound; (4) of the persons of all concerned in its dressing.

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* See for example Sir W. McCormack's "Antiseptic Surgery." Smith, Elder & Co. 1880; or Mr. W. Watson Cheyne's work on the same subject. 1882.

Moreover, this method is concerned not only with the dressing of the wound in an absolutely cleanly fashion, but with the maintenance of it in this condition.

Purity of the air.

Purity of the air surrounding the wound.

This is attained by making a spray of steam, or of air, loaded with carbolic acid, which must envelop the hands of the operator and assistant, and all the parts about the wound.

Such a spray may be produced by an ordinary "hand bellows spray producer," and this will do in default of a better. But steam produced under a working pressure of about 60 lbs. to the square inch, from a copper boiler, is now almost always used as the agent to diffuse the acid.

The spray producer.

A good pattern of a steam spray is figured below (Fig. 133), and though a verbal description of its several parts would be lengthy, a minute's inspection will enable

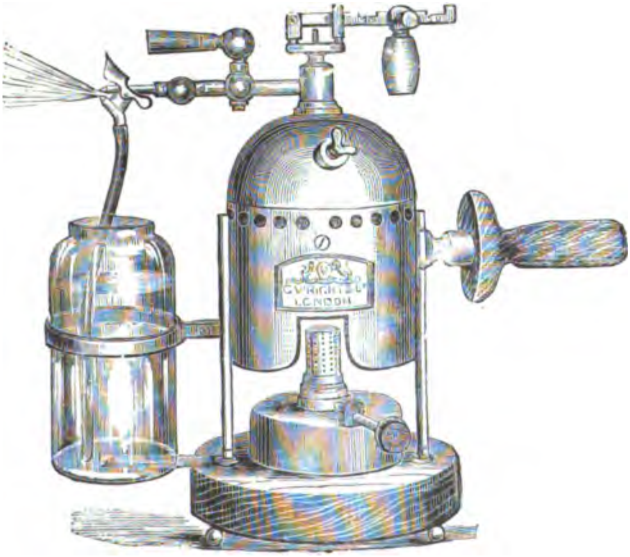

FIG. 133.—*Steam Spray Producer.*

any intelligent person thoroughly to understand its working.

A full sized spray will use up about 12 oz. of water, and a somewhat larger quantity of the acid solution, in an hour, if one nozzle alone be used. The strength of the carbolic solution in the reservoir should be 1 in 20.

The following are the chief points to be borne in mind in the management of the spray:—

The lamp. The trimming of the lamp must be looked to carefully, and care taken that there is spirit enough to last half as long again as the spray is expected to be required.

The water. The water should be put into the boiler nearly boiling, or much time will be wasted; it should never be allowed to boil away.

As soon as the necessary pressure of steam is produced, the lamp should be turned down, so that the flame is just enough to maintain an efficient spray.

The safety valve should not be loaded beyond the minimum pressure, in all ordinary cases, to avoid straining the boiler.

The tube, up which the carbolic passes, should have a metal T piece at the lower end, into the cross pieces of which two small pieces of sponge should be placed, to prevent any grit passing up and clogging the nozzle.

The carbolic acid. The reservoir should be watched to see that the supply does not run short, and care should always be taken that there be no settlement of undissolved acid at the bottom, as may happen in badly made solutions.

In cold weather a little gain in the warmth of the spray may be attained by warming the acid solution.

The spray must be so placed that it shall not play on the face of the patient, and must be at that distance which will allow the finest part of the steam cloud to envelop the wound.

If, by any mischance, the spray ceases to diffuse the acid, it becomes bluish, and less noisy. The wound must then be immediately covered up with a pad of soaked carbolic gauze, or with a large carbolised sponge, which should be kept ready to hand.

If either the steam or acid nozzle gets choked, it must be cleared by passing a fine wire, *never a pin*, down it. The lamp should be turned out directly the spray ceases to be used, and the boiler emptied.

Purity of the instruments. *Purity of the instruments.*

All instruments and needles should be got ready beforehand, and these together with the drainage tubes, ligatures, and everything with which the wound may have to be touched must be placed in shallow pans and covered with a 1 in 20 solution of carbolic acid. Unless this be done, there will always be a risk of something being snatched up in a hurry, before it has been passed through the solution, but both this precaution, and the habit of placing the instruments in the solution in the intervals of their use, will soon be automatically carried out by any surgeon who means to be thorough.

Of the sponges.

Sponges may safely be employed if they be kept perfectly clean, but those used for antiseptic dressings should be kept apart from those in ordinary use, in a closed vessel filled with a 1 in 20 carbolic acid solution. After use they should be washed in water, and then in a solution of washing soda, and replaced in the vessel. During an operation or a dressing they should be cleansed in a 1 in 40 solution, as required.

Of the operator's hands, etc.

Purity of the persons of the dressers and surgeons.

In addition to ordinary washing, the hands of every one who may be required to touch the patient should be thoroughly rinsed in carbolic acid, about 1 in 40, and if at any time during the dressing the hands come in contact with material which has not been carbolised, they should again be put in the solution. It is generally convenient for the surgeon or dresser to wear over the sleeves a pair of gauntlets or cuffs, which may conveniently be made of the pink waterproof material, described on page 245. This will protect the coat-sleeve from the soaking spray, and its smooth surface is easily kept aseptic.

Of the wound and adjacent parts.

Purity of the wound and adjacent parts.

This is in great part secured by the spray, but other precautions are needful. The edges and neighbourhood of an accidental wound, or the skin surface where an operation wound is about to be made, must be washed, or rather scrubbed, with the 1 in 20 or 1 in 30 carbolic solution. If hairs are growing over or near the part, they must be cut close or shaved. The other parts of the limb or trunk should be protected from the spray by macintosh sheeting,* and a very effectual "cordon" of aseptic material may usefully be made, by disposing a towel, or towels wrung out of 1 in 40 solution, around the parts concerned in the operation or the dressing.

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* Waterproof sheeting must also be used to protect the neighbouring blankets or clothes from the spray.

The details of the arrest of bleeding, the drainage, and the application of sutures, are those which have been already described. Forcipressure or torsion may be freely employed, and a silk ligature may be used if the occasion calls for it, but catgut is the material which will most commonly be employed. The general rule as to the desirability of arresting all hæmorrhage before the wound is closed, applies with equal force to antiseptic wounds as to others, for though a blood clot, lying in the cavity of such a wound, may certainly become organised, or at least be replaced by organised tissue, its presence is to be avoided if possible. The wound having been closed, and the drainage tube adjusted, a final syringing with 1 in 20 carbolic solution should always be performed, and that so thoroughly, that the whole of the wound cavity is distended and all blood clots washed away.

The covering or dressing of antiseptic wounds.

Whatever the wound may have been, it should be now absolutely aseptic, and the next point to consider is how it is to be "dressed," that is, *covered up*, so that the changes which it will go through from this time, until it is completely healed, may be performed in an absolutely healthy fashion, without fever, suppuration, or pain. In a chemically pure atmosphere, this would be attained without further precautions, and even in good country air, operation and other wounds will run an aseptic course with any simple dressing. But in hospital wards, and in most dwellings, precautions must be taken to prevent the germ laden air from coming into contact with the wound, or with whatever in the way of discharge may be coming from it, unless it has been previously purified.

The use of the gauze, etc.

This is the *rationale* of the gauze dressing of Listerian wounds, and it is founded on the same reasoning as the preservation of putrescible fluids from decomposition in test tubes, by inserting pledgets of cotton wool into the mouths of the tubes, the fluids being at the time free from anything which can set up septic changes.

Details of the dressings.

Over the wound itself is first placed a strip of green oiled silk, made impermeable to moisture by copal varnish, and then coated with a thin layer of dextrine. This "protective" keeps the edges of the wound from being irritated by the gauze. The end of the drainage tube should come through a hole cut in it; the silk must be soaked in a 1 in 40 carbolic acid solution before application.

Preparation of the gauze.

The dressing which is applied next, is a very loosely woven "gauze" or muslin, unbleached, and saturated in a mixture of carbolic acid, resin, and paraffin, in the proportion of one part of the acid to four of each of the other ingredients. The resin makes the muslin somewhat sticky, and this greatly adds to the firmness of the dressing.

This gauze is used in the form of pads, rollers, and of loosely crumpled up pieces, which serve to fill up crevices, and to absorb discharges, and which is called "gauze waste."

Over the protective there is generally placed a pad moistened with 1 in 40 carbolic acid solution; this serves for firm, even pressure on the wound. Over and around the pad a sufficient quantity of gauze waste must then be disposed, especially about the lower parts of the wound, the amount varying according to the amount of discharge which is expected. A few turns of a gauze roller may conveniently be used to fix these internal layers of the dressing, and if a firm pressure be wanted, as very generally happens, it should now be applied. Then a large square, or shaped piece, eight or twelve layers thick, is placed over the whole, and bandaged on with another roller as firmly as is necessary.

The waterproofing.

Between the outermost layer of this piece and all the rest, a piece of pink waterproof sheeting is placed with the smooth face towards the wound; it should be a little smaller all round than the gauze. Its use is to prevent the discharge coming into contact with the air when it has soaked through all the layers. The waterproofing should be sponged with 1 in 40 carbolic before it is placed between the gauze layers.

This outer piece must be large enough to well overlap the inner gauze dressings, and to serve as a general wrapper over all. The spray should not be turned off until this outer piece has been applied, when the dressing may be considered finished, so far as the antiseptic measures are concerned.

Re-dressing.

The steps to be taken at the future dressings are precisely the same as for the original one. The spray must be turned on directly the outer bandages are loosened, and all the precautions for cleanliness of hands, instruments, etc., must be as rigidly carried out.

Time of.

It is impossible to lay down rules as to the time of re-dressing. Some cases may be left for weeks, indeed, until the wound is completely healed, while others will require to be dressed daily. Other things being equal, the period depends upon the amount of discharge, for as soon as there are signs of this coming near the surface, the time for fresh dressing has come, though a little delay may safely be allowed if additional external layers of gauze are immediately put on.

Any circumstance which arouses a suspicion that things are going wrong, such as undue pain, or a high temperature, will call for prompt re-dressing. The wound will be known to be aseptic, by the absence of smell, or of any discoloration of the silver sutures, or of the oiled silk; its edges should present a quiet, inactive appearance, and there should be very little tenderness anywhere. The discharge should be serous, or in recent cases, blood stained, moderate in amount, and freely discharged through the tubes.

In re-dressing, the skin surface around the wound should be lightly sponged with 1 in 40 carbolic solution, and gentle pressure made to ascertain that there is no bagging of discharge. The drainage tube should be taken out, syringed through with 1 in 20 carbolic and replaced (being shortened if necessary). The wound should not be syringed through, as this will only separate parts which are adhering. If at any time the wound becomes in the least offensive, or freely suppurates, antiseptic precautions may be said to have failed, and may be discarded at once for more simple measures.

Modifications of the Listerian plan.

Modifications of the Listerian plan.—At the commencement of this chapter we have given some account of the recent methods of antiseptic dressing which have so far departed from the original plan that they cannot be rightly called "modifications" of the Listerian dressing. The new antiseptic materials used in these dressings are chiefly solutions of corrosive sublimate, in strengths of from 1 part in 800 to 1 in 2000, corrosive sublimate gauze, or wood wool, moss, oakum, etc., similarly impregnated, iodoform powder, or iodoform gauze. But all of these, with the exception perhaps of iodoform powder, are used for dressings otherwise strictly Listerian. Again, with regard to the spray, some surgeons have abandoned it while retaining all other precautions, while others only turn it on at the conclusion of an operation and while the dressings are being applied.

Some surgeons syringe the wound out with a carbolic solution at each time of dressing, as a matter of routine.

Carbolised ointments should also be mentioned as being used in antiseptic dressings, in the form of Professor Lister's "carbolic cream," or as a mixture of the acid with vaseline, and a dry carbolised atmosphere has been attempted in two or three different ways, but hitherto without practical success.

Thymol. Other substances have been substituted for carbolic acid in the spray. The chief of these is *thymol*, a not distant chemical ally of carbolic acid. Gauze bandages may also readily be impregnated with it. The antiseptic properties of this substance are certainly inferior to carbolic acid, and its thyme-like smell soon becomes annoying.

Salicylic acid and wool. Salicylic acid has not been used in the spray, but in *salicylic wool* we have a material, little, if at all inferior to carbolic gauze as an antiseptic, and which, mechanically, has in some respects distinct advantages.

Salicylic wool is an absorbent wool (*i.e.*, cotton, from which all grease has been removed by alkalies), which having been soaked in an alcoholic solution of the acid, and then dried, retains it within its meshes in crystals.

In many instances the wool may be entirely substituted for the gauze, the whole dressing simply consisting of a sufficient quantity of the wool placed over the wound, and covered with a bandage; but most commonly the wool is used with the gauze, supplying the place of the gauze waste, in filling up interstices and corners. Care must be taken to shake it about as little as possible, for the acid particles are peculiarly irritating to the nostrils and throats of the bystanders, and it should be cut, not torn.

This acid can also be employed to impregnate jute, a much cheaper material, and 1 part dissolves in about 10 of alcohol. The strongest watery solution, 1 part in 300, is a good antiseptic lotion for washing out abscesses, etc., but is not so powerful as carbolic acid.

Carbolic tow, etc. In consequence of the expense of the gauze, *felt* and *tow* are also largely used on the Continent; they are impregnated with carbolic acid in the same way as, but hold even more than, the gauze. On the other hand, a more comfortable and much more expensive gauze is manufactured by carefully bleaching and softening the coarse muslin commonly employed, before it is impregnated with the acid.

Mercuric dressings. But the two antiseptics which are now most used in the preparation of dressings, are (1) sal-alembroth (a double salt of perchloride of mercury and ammonium chloride); and (2) the double cyanide of mercury and zinc. Sal-alembroth gauze contains 1 per cent., and the wool 2 per cent., the mercuric zinc dressings about 3 per cent. of the salt; the former are coloured blue and the latter violet, the colouring matter not only rendering the material easily recognizable, but also serves, in the case of the mercuric zinc, to fix the salt in the dressings. The disadvantage of the alembroth preparations is that the discharges from the wound readily dissolve the salt, and soaking in the dressings take up a larger and larger amount, until the solution may become strong enough to cause vesication of the skin. In using either dressing a layer of gauze, which has been wrung out of 1 in 2000 mercuric chloride or carbolic solution, is first applied; over this several layers of dry gauze, and finally, a plentiful covering of wool.

The following substances may also be used as dressings or washes for wounds, which in other respects have been treated on the Listerian plan, and may keep them in an aseptic condition, but none, as far as we know at present, are as certain to do so as the carbolic or corrosive sublimate gauze or the salicylic wool.

Carbolised oil lint.

(1) *Lint* soaked in 1 in 20 to 1 in 40 carbolic oil, as recommended in the ordinary dressing of wounds. This is sometimes useful in plugging wounds, as in operations for caries or necrosis.

Boracic acid.

(2) Preparations of boracic acid. (*a*) *Boracic lotion*, a saturated watery solution (about 4 per cent.) is odourless and non-irritant; it is generally tinted pink with litmus to distinguish it from plain water. It has been used in the spray for operations, but more commonly for throat affections. (*b*) *Boracic lint*, this contains nearly its own weight of the crystals of the acid. incorporated by soaking the lint in a boiling saturated solution, and drying. It is also generally coloured pink. This material is also largely used in ordinary non-Listerian dressing. (*c*) *Boracic ointments.* Mixtures of the acid with wax or vaseline are aseptic and non-irritant. The former is made of 10 parts of the acid, 10 of white wax, and 20 parts each of almond oil and paraffin. The vaseline ointment is a 5 to 10 per cent. mixture.

Boroglyceride.

Boroglyceride, introduced by Professor Barff as a means of preserving meat from decomposition, was soon employed in antiseptic surgery.* It is a semi-solid substance, like half-melted stearine, and is soluble in water. A 5 per cent. solution is generally used, both to wash the wound and to saturate lint for dressings, but it mixes also with vaseline as an ointment.

Eucalyptus oil.

Eucalyptus oil is a good antiseptic, and is recommended by Prof. Lister† to be used when carbolic acid is not advisable.

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* For a full account of its use, by Mr. Barwell, see *British Medical Journal*, 1882, Vol. II., p. 362; also p. 371.

† See *Lancet*, January, 1881, p. 828.

An antiseptic gauze may be made with a mixture of 1 part of the oil, and 3 parts each of dammar and paraffin; or a mixture of dammar and the oil may be used with lint. It also mixes with olive oil.

Other antiseptics.

The following substances need only be enumerated as possessing distinct antiseptic properties, and having a more or less extended employment for that end:—Acetate of alumina, oil of turpentine, naphthalin, sugar.

CHAPTER XVII.

WOUNDS CONTINUED.

OF THE DRESSING OF BRUISED AND PUNCTURED WOUNDS, AND OF CERTAIN SPECIAL KINDS OF WOUNDS.

Of the Dressing of Bruised Wounds.

All wounds *may*, but bruised wounds *must* go through certain phases of inflammation ending in suppurative granulations. The accepted pathology of this process is to be found in all recent text books, but no modern word expresses it so well as the old-fashioned phrase of the *digestion of the wound.* As soon as this is accomplished, and not till then, the wound "cleans" and begins to heal; and if this old word were more often in our thoughts and mouths, we should more rarely see wounds with bruised and inflamed edges coerced into contact, but never into union.

The digestion of the wound.

Its nature and extent.

The extent of this "digestion" varies from that condition when the edges of the wound just fail to unite by first intention, but quiet down, clean, and take on a healing action within a couple of days, to that which occurs when for a considerable area round the wound the tissues have been bruised to death, and múst separate as sloughs before any healing can take place.

As soon as this process is finished, whether the merest pellicle of lymph, or a large slough, has been thrown off, the wound presents few difficulties in the way of its dressing, and any of the plans or materials before mentioned may be used. All the precautions of drainage and cleanliness must be rigidly carried out, for though the protective power of granulation tissue against septic poisoning is very great, blood poisons may yet be absorbed through it.

Importance of the relief of tension.

It is, therefore, in their earliest stages that bruised wounds present special points in their dressing; in these injuries the internal tension which is sure to develop in the tissues in the immediate neighbourhood of the wound, must be diminished in every possible way; moreover, as the whole process is an inflammatory one, and may be septic as well, the cleansing of the wound, and the removal of all discharges by drainage, etc., must be carefully attended to.

Bruised wounds not to be tightly closed.

A bruised or torn wound should never be tightly closed up, and this not only because the edges will not unite, but because the dragging together of tissues of doubtful vitality must still further reduce their chance of recovery. The wounded parts should be replaced and supported in a gentle fashion, by strapping or bandaging. If sutures are put in they must serve for support rather than for readjustment, while in small wounds where there has been no tearing off of flaps of tissue, it is often best to leave the wound entirely open.

Must be drained.

In all cases, unless the wound be left open, it must be drained even more carefully than a clean cut, and whatever be the dressing which is applied, it must be of a kind that will keep down the swelling and tension, prevent fœtor, and hasten the separation of the sloughs, if any have formed.

Their dressing.

For these ends poultices and water dressings, the former especially, frequently changed, are very useful.

Management when fœtid.

If the wounds become foul, charcoal poultices, or Condy's fluid, or terebene, or any of the deodorising dressings already mentioned may be used. In such cases, too, *irrigation* finds its best application, and a foul gangrenous wound will often become sweet in an hour or two under a trickling stream of carbolic or Condy's fluid. In other cases, lint soaked in carbolic oil will suit best. If the discharge be very profuse it should be taken up with pads of absorbent cotton-wool (the salicylic wool is the best), or of wood wool, or, as recommended by Surgeon-Major Porter, bags of muslin, filled with fresh red pine sawdust, may be placed beneath or around the wound. Another good way of cleaning a foul wound or ulcer is to allow the carbolic spray to play upon it for an hour or two.

All the arrangements for the support and approximation of the edges of the wound must be carefully watched lest they should become a cause of tension, and therefore of destruction of vitality. Stitches must be promptly cut, and strapping removed, almost *before* there are any indications for such relief.

Use of incisions to relieve tension.

Sometimes, but rarely, the congested area around a bruised wound requires incisions to be made in it, as is so frequently the case in erysipelas (*q.v.*) for the effectual relief of tension.

Punctured wounds.

Punctured wounds, though often very difficult to manage, call for no lengthy consideration. The great point to bear in mind, and the great difficulty to combat, is to prevent discharges from being shut up in the depths of the wound by a premature closure of the superficial parts. The drainage of these wounds is often a very troublesome matter, because it should be done from the bottom, and the mistake of inserting a drainage tube through the puncture, so that the place of exit for the pus is the highest part of the wound, must be carefully avoided.*

Of certain special wounds.

Of certain special wounds.

The particular wounds we are now about to consider have, some of them, been before mentioned from the viewpoint of the arrest of bleeding, so that this complication must, for our present purpose, be excluded; nor, again, shall we consider those wounds which are inflicted in the course of major surgical operations.

Scalp wounds.

Scalp wounds.

These are very generally bruised wounds, although in consequence of the way in which the tissues of the scalp are stretched over the calvaria, they almost always look like incised ones, even if they be produced by the bluntest of instruments or missiles.

Sutures may be used.

It used to be laid down as an inflexible rule that sutures should never be put into scalp wounds, partly because their edges so very generally fail to unite, but principally from the risks of the bagging of pent-up discharges inside the wound thus closed. It is now recognised that these risks are better avoided by proper drainage, and that the tissues of the scalp are so well nourished that not only in clean cuts, but also when the parts have been split upon the skull by a blunt instrument, the edges may yet unite by first intention if they be accurately brought together, and tension be carefully guarded against.

But drainage from the bottom is here an absolute necessity for safety, and it may often happen (as when the scalp is much torn) that the lowest part of the cut itself is not the bottom of the cavity of the wound.

In such a case, the best plan is to make a puncture big enough to admit a drainage tube through the scalp tissues at the lowest point of their detachment, so that the wound cavity may be tapped at its very bottom. The edges of the flap are best adjusted by points of silver suture, but it is even more important to give support to the whole of the portion of scalp which is detached. This may be done by pads of lint or of absorbent cotton wool, or sometimes a flat sponge will be found to give just the firm elastic kind of pressure required.

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* Much may often be done, by attention to the position of the patient, to aid the drainage of punctured, and of other wounds.

Dangers of infiltration or bogginess.

These wounds must always be watched carefully, and the whole head should be daily examined for that kind of œdema which is known as "bogginess." The sutures must be taken out, and the adhesions broken down if there be any collection of pus. Generally the thermometer will give an early warning of collecting matter.

Actual dressing.

With regard to the dressings, no wounds are better fitted for the antiseptic method, either with the gauze or salicylic wool, or both. If the plan is to succeed thoroughly, the head must be shaved for some distance around the wound. For ordinary dressings, of which carbolic oil or simple water dressing is probably the best, it will only be requisite to shave or clip the hair in the neighbourhood.

Sloughing.

If sloughing takes place (which is rare), boracic fomentations will generally be the best dressing, but irrigation is sometimes to be preferred.

Necrosis.

A superficial necrosis of the skull often occurs in connection with scalp wounds. The bone may separate as a scale of sequestrum, but more commonly the dead white patch of bare bone which is at first exposed, becomes more and more encroached upon by granulations, and is eaten up, so to speak, by them, almost insensibly.

Cuts of the ear.

Cuts of the ear. The special point about these wounds is that the vitality of these parts is very good, so that torn pieces, however nearly detached, should almost always be replaced. Every care should be taken to prevent future deformity. If the cartilage be torn, sutures should not be passed through it and the skin together, but cartilage must be sewn to cartilage, and skin to skin. The whole organ must be kept warm by cotton wool.

Cut throat.

Cut throat. This may be among the most serious of all wounds, even to being immediately fatal, or may be absolutely trivial. It is almost always suicidal or homicidal.

The especial dangers.

Apart from the question of hæmorrhage, the especial dangers of these wounds are, primarily, the possible injury to the air or food passage, or to both; and, secondly, the danger of pus tracking down within the compartments of the cervical fascia, involving the pericardium or pleura, or leading to septic poisoning.

Injury to the air passages.

In self-inflicted wounds, fortunately, owing to an apparently innate tendency of the suicide to attack his "pomum

Adami" in preference to any more vital part, the respiratory tract escapes more often than might have been expected. When it is injured, the knife or razor almost always divides the thyro-hyoid membrane, so that the rima glottidis is exposed, while the epiglottis is frequently cut away from its attachments. The cartilages of the larynx themselves will resist almost any cutting, and from anatomical reasons it follows than any division of the tracheal tube, or of the crico-thyroid membrane, is accompanied by such injury to the great vessels that the bleeding quickly causes death. In most cases, therefore, the larynx is more often exposed than entered, when the pharynx is laid open, but sometimes a downward direction of the cut exposes the top of the larynx alone, while in others the œsophagus may be laid open behind the opened larynx. In all these cases the proper performance of breathing and swallowing will be greatly interfered with.

Risks of asphyxia; how guarded against.

If, on examination of the wound, there seems to be general laying open of the pharynx and larynx, and the chink of the glottis be freely exposed, œdema of the latter is practically certain to come on, and its effects had better be anticipated and combated by inserting a full-sized laryngotomy tube through the crico-thyroid space, carrying out all the precautions of steam inhalation, etc., which will be described under the head of the operation of tracheotomy. If, however, the exposure of the glottis be slight, the membrane being rather "nicked" than divided, the patient should be anxiously watched, the steam inhalation and the instruments for tracheotomy being ready at hand, so that they can be used at once if sudden dyspnœa occur.

Administration of food.

When the *pharynx* is wounded, food, when swallowed, may escape by the wound, and may also set up irritation of the larynx. Both these complications are very hurtful, so that it becomes necessary to get the food past the wound in the œsophagus.

By stomach pump.

For this purpose a very soft stomach pump tube may be sometimes successfully introduced by the mouth, and the pump, or a length of tubing fitted with a funnel, employed. (*Vide* use of stomach pump.)

By catheter through the nostril.

But a better plan is to pass a large soft catheter into the pharynx through the nose. Introduced in this way, the tube will lie at the back of the food passage and little or no spasm will be set up by its insertion. The catheter should then be connected with a tube and funnel, and in this way liquid food may safely, and indeed easily, be given.

Prognosis.

The prognosis in the cases of bad cut throat which we have been considering, is always unfavourable, for, apart from the injury itself, there is, very generally, a complete absence of any desire to get well. Nevertheless cases apparently hopeless do sometimes recover.

Position of head.

Whether the air or food passages be wounded or no, the position of the head is important—it should always be kept bent downwards, so that the edges of the wound may come together. Two or three patterns of bandages have been devised for this purpose. We believe that no restraint is ever required, and that patients will always naturally, and of themselves, keep their heads forward, to avoid opening the wound, unless delirium be present, in which case any form of bandage would almost certainly fail.

Use of sutures.

Sutures may be employed in cases of clean cut wounds not implicating the air passage, but care must be taken to provide free drainage, and watch must be kept for the formation of pus, on account of the tendency of the latter to burrow amongst the planes of the cervical fascia. Sutures should not be used when the edges of the wound are jagged and bruised, and the same rule is to be enforced after wounds involving the trachea or œsophagus. It may be absolutely necessary, however, to apply sutures to trachea or œsophagus should there be much separation of the parts after deep wounds inflicted in them. Strict antiseptic precautions should be observed in dressing all wounds.

Pneumonia.

Whether septic absorption occurs or no, a low form of pneumonia is very apt to develop, and is very often fatal. A stimulant treatment generally, with alcohol, will be, as a rule, required, and in suicidal cases a careful watch must be kept upon the patient.

Wounds of the buttocks.

Wounds of the buttocks. A very awkward wound is sometimes inflicted upon the buttocks by the fracture of a chamber utensil whilst it is sat upon. This almost always happens to heavy women. Such an injury, or indeed any wound of that part is very apt to take on unhealthy action, as wounds in loose fat will do anywhere in the body; they will rarely heal by first intention, and care must be taken that the discharges are allowed to have a very free exit.

Wounds into joint cavities.

Wounds into joint cavities. With the exception of the smallest joints, and sometimes even in them, any wound by which the interior of a joint is exposed is a very serious occurrence, and even when the injury at the outset may seem to be only the most trivial cut, it may well happen that in the end there will result a destruction of the joint, or a loss of the limb, or it may be of the life.

Are always serious.

May be divided into—

Wounds into joints may be divided practically into two classes. Under the first heading fall those cases in which the wound is a small one, or the injury in itself unimportant, only being serious because a joint is entered. In the second class come all the cases of wounds with disorganisation of the joint structures, laceration of the capsule, free exposure of the cavity, rupture of the ligaments, etc.

1. Simple wounds of joints.

Simple wounds of joints, *i.e.*, where the joint is just opened, and no more, by an incised wound. The first and very important point to bear in mind with regard to these injuries is that in cases where there is any doubt as to whether the joint has really been opened, under no circumstances should any attempt be made to decide the question by probing, or in any other way. More mischief has often been done by an unnecessary use of a probe than by the instrument which inflicted the wound in the first place, and the only safe rule to follow is that in cases of doubt the joint must be supposed to have been opened, and be treated accordingly.

Dangers of probing.

Treatment.

If the wound be just a simple puncture, in which the fact of the joint being opened has been proved by the escape of a few drops of synovia, the limb should immediately be put on a splint, and if the knee or ankle, it should be swung from a cradle. An ice bag should be put over the joint, and the wound covered with some collodion, or a pad of gauze or lint.

If, however, the wound has more distinctly opened the joint, a decision will have to be made between treating it on the general principles of cleanly surgery, or on the Listerian plan. If the latter course be decided on, the same details will have to be carried out, as will be directly described in the case of disorganising wounds, and in any case the limb will have to be most carefully splinted, and the joint fixed in the position of complete rest, which will be in almost all cases, one of slight flexion.

If the more general plan of dressing be carried out, the edges of the wound should be gently drawn together with strapping or sutures, a small drain inserted into the wound, and water dressing or carbolised lint placed over all, while an ice bag should be kept constantly applied. If the joint should get hot or full, leeches (say six for an adult knee) will often prove of great service, and the patient must be kept rigidly on a low diet.

Treated in this way with good hygienic surroundings or in country air, especially if the patient be a good subject for recovery from injury, wounds which have communicated with a joint will often heal up straight away, and no serious synovitis be developed. Nevertheless it is the opinion of most surgeons at the present time that wounds of joints, except the smallest punctures, are more safely treated on the Listerian plan.

2. Where the joint is freely exposed.

But even if we allow that cases occur which may fairly be considered to belong to a debatable class, there is no question but that all those in which the joint can in any sense be said to be exposed or to have its investing or lining structures seriously injured, should be treated with strict antiseptic precautions. The joint must be thoroughly syringed out with carbolic lotion; provision must be made for the thorough drainage of the joint cavity, if necessary, by counter puncture or incision. In fact, all the details of the dressing described in Chap. xv. must be observed, while, of course, splinting and swinging are as necessary now as ever.

Results of traumatic arthritis.

If the antiseptic precautions fail of their object, or if they have not been adopted, acute synovitis will surely follow. This is almost certain to run on to suppuration, and this practically means, at the best, anchylosis; while very possibly a subsequent excision or amputation may become necessary.

But we must not here discuss the surgery of traumatic arthritis; we hope that enough has been said to impress upon the reader the extreme importance of *all* wounds which even by the smallest aperture communicate with a joint.

Wounds of tendons.

Wounds of tendons.

Tendons, especially those of the muscles of the hand or foot, are frequently divided in wounds of the extremities, and the manner in which they will re-unite will depend greatly upon their immediate treatment.

Treatment.

The cut ends of the tendons should be drawn out of their sheaths and stitched together by three or four catgut or silk sutures passed through the tendinous substance; their ends may then be cut short. The tendon having been joined, the sheath should then, if possible, be closed with a few points of the finest catgut suture, and the rest of the wound adjusted and drained in the usual fashion. The limb, after dressing, must be placed on a splint in the position which causes least strain on the divided tendons. A flexible tin splint, which can easily be bent to the proper shape, will be found most useful.

Inasmuch as the great risk attending these wounds is the diffuse inflammation which is apt to attack the sheaths of tendons, and which is almost always of an erysipelatous, that is of a septic nature, it will be seen at once that the Listerian dressing has here great advantages, and should be adopted whenever it be possible. But with attention to drainage and with perfect rest on a proper splint, these cases will often do very well with simple water, or oily, or dry absorbent dressings. Even if it is not possible to get the ends of the tendon quite together, they will probably join eventually by the formation of an intervening band of firm fibrous tissue, if no acute inflammation disturbs the healing process.

Wounds of nerves.

Wounds of nerves. All that has just been written with regard to divided tendons will stand for similar injuries to nerves. They must be searched for, joined, and the wound dressed in just the same way. There need be no hesitation in passing the sutures through the nerve trunk, but gentle handling, and the finest sutures are required.

Importance of early union.

The sheath of the nerve does not usually call for separate suturing, but great care must be taken to see that the cut ends of the nerve tubes come into contact, or at any rate are brought face to face, without overlapping. If this be done soon after the injury, repair of structure and function will very probably take place, for nervous tissue resists the effects of injury almost better than any other. Even if an interval of half an inch were to exist between the divided ends, they might eventually come together if no barrier lay between; and it is well known now how nerve trunks will recover their functional activity when re-united, even when the ends have been lying apart for weeks or months.* The great enemy to repair is, as Mr. Page has pointed out,† suppuration.

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* See on the subject, Mr. Page, "On the Immediate Suture of Divided Nerves," *British Medical Journal*, Vol. II., 1880, p. 347, and Vol. I., 1881, p. 717; and the Author for a case of restoration of functional activity to the ulnar nerve after strangulation for 16 months, due to suppuration of an operation wound (*Brain*, July, 1885).

† *Loc. cit.*

CHAPTER XVIII.

OF GUNSHOT WOUNDS AND BRUISES.

Gunshot wounds.

Gunshot Wounds. These were, at one time, supposed to form a class of injuries differing in their pathology from all other wounds, and requiring different treatment. They were taken to be essentially poisoned wounds, and the main idea in their dressing was to encourage local inflammatory action and to delay union, until by profuse suppuration the poison (generally supposed to be due to the gunpowder), had been completely eliminated.

This notion naturally led to a very barbarous system of dressing, and it was not until it was recognised that these were essentially and typically *bruised wounds*, that more rational plans were adopted.

Only the more simple cases of this class of injury, or those in which some immediate treatment is called for, can here be considered as belonging to minor surgery; and with this limitation it will be found that their surgical dressing will not differ much from that of all other contused wounds.

The hæmorrhage is generally slight, but whether slight or severe must be arrested on general principles.

Extraction of the bullet.

The next point to consider is whether the bullet, or whatever may be the missile employed, be still in the wound; and if so, whether an attempt should at once be made to extract it. To decide this point an exploration should be made, and if possible, with the finger; and speaking generally, if by this means a foreign body be felt, it can without difficulty be extracted, with a pair of ordinary dressing forceps, or with ones **Forceps.** especially made for the purpose, as shown in Figs. 134 or

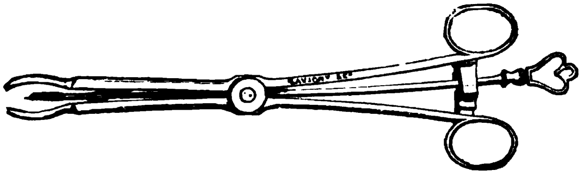

FIG. 134.—*Bullet Extracting Forceps.*

135, or with Coxeter's bullet extractor (Fig. 136). Search should also be made for any piece of wadding, cloth, etc., which may have been carried in with the missile. If nothing can be felt with the finger, then a further examination must be made with a silver probe, or one tipped with porcelain (Nelaton's), Fig. 137, by which the bullet may be detected, as in the case of Garibaldi, by the mark of the lead on the porcelain.* In making this examination the patient must always be placed accurately in the same position as when the wound was received, a precaution which is often overlooked.

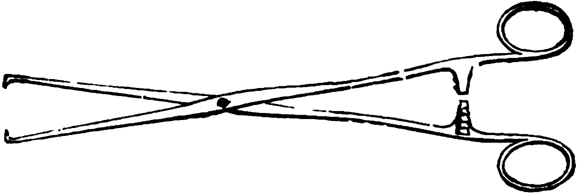

FIG. 135.—*Luer's Forceps.*

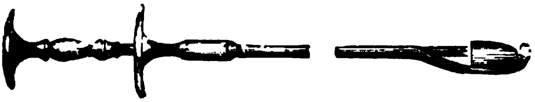

FIG. 136.—*Coxeter's Bullet Extracter.*

Probing for the bullet.

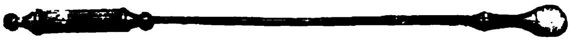

FIG. 137.—*Nelaton's Probe.*

Unless the probe detects the bullet to be in a place whence it can easily be extracted, the responsibility of attempting to recover it, or of deciding to leave it alone, should not be left to the dresser, or junior surgeon, nor indeed should the patient be subjected by them to a prolonged, or deep probing.

Sometimes a bullet will travel a considerable distance from the original wound and be found still lying immediately beneath the skin. Thus a pistol bullet may run almost all round the skull beneath the scalp, or round the thorax in the course of the ribs. In such a case a small incision will allow of its escape; the track of the ball however will almost certainly form a suppurating sinus.

Whether the bullet has passed out of the body, or has been removed, or has been left, it is vain to hope that the wound it has caused will ever unite by first intention. After a period of inaction, inflammation, with suppuration, and more or less sloughing, will take place, as in all bruised wounds, and this will be succeeded by repair by granulation.

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* Sayre's vertebrated probe is recommended for this purpose, but we have never found it at all serviceable.

Dressing.

The dressing should therefore be light, and great care must be taken to keep the wound clean in every possible way. Sometimes fomentations will be found to hasten the separation of the sloughs, but as a rule antiseptic dressings will be the best to use.

Bruises.

Bruises. Whenever capillaries or veins are ruptured in or beneath the skin, some variety of *bruise* is produced. Under this head fall two chief kinds of injuries. In the first there is a general infiltration of the tissues, in the second there is a bag of blood, and speaking generally in the one the capillaries, and in the other a vein of some size, has been ruptured. In either case the great point to keep in mind is, that the effused blood should be *left alone*, except under one or two quite exceptional conditions.

The common bruise, or infiltration of blood.

For the common bruise, or infiltration of blood, in the vast majority of cases, no special treatment is required. It is very doubtful if any external application can appreciably affect the reabsorption of the effusion, or the course of the discoloration, but it is probable that local cold and astringent dressings may be useful, if applied early, in limiting the extent of the primary escape of blood. For this purpose diluted tinctures are often used, especially tincture of arnica, or evaporating lotions.

Dressings, cold and astringents.

The astringent action of strong liq. plumbi subacet. is also very effective, and the actions of cold and astringents may be combined.

Compression

A still better line of treatment is that by firm, even compression, but only when it can be applied in time to prevent the infiltration of the tissues taking place. A wet bandage, smoothly applied, or a Martin's india-rubber roller may in such cases absolutely prevent the development of an ecchymosis.

This moderate pressure can never be hurtful, but it must be remembered that the vitality is greatly lowered in bruised tissues, so that all tight constriction, or unyielding compression, as that of a circular piece of strapping, or the corner of a splint, must be avoided* lest an ulcer should be caused, which would certainly be slow to heal.

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* We often see the effects of pressure in limiting ecchymosis, in cases of sprained ankle, when in taking off the boot, the discoloration is found to be sharply limited at the level where the ankle is encircled.

Relief of tension. Severe bruises will often be associated with great swelling and tension of the parts. This must be met by position and bandaging; only in the most extreme cases, when the vitality of the surrounding area of skin is seriously threatened, should the surgeon be tempted to relieve this tension by operative measures. The conditions are just the reverse of those present in inflammation, and an extraordinary degree of stretching will be now borne by the tissues without their giving way or sloughing. **Incisions.** If it becomes absolutely necessary to incise an ecchymosed area, small and numerous punctures should be made, and antiseptic precautions adopted. But it is, we repeat, generally bad surgery thus to interfere with the natural process of re-absorption.

Hæmatoma. When a fairly large vein is ruptured beneath the skin, *a hæmatoma*, or bag of blood, is the result, and much of what has just been said will apply accurately to its management. The fluctuating swellings thus caused are sometimes very large. Thus the rupture of the saphena vein may cause an effusion which will give a wave of fluctuation from the knee to the crest of the ilium, and, generally speaking, the blood thus poured out does not coagulate in the same way as if it had escaped from the body. Nothing but tension so extreme that the vitality of the parts is seriously threatened, or the occurrence of suppurative inflammation within the cavity (which is rare), should induce the surgeon to open these bags of blood. Rest, position, local cold, and especially, carefully regulated pressure, as with india-rubber or other bandages, will in almost all cases effect their re-absorption. They do, however sometimes suppurate, and sometimes they remain with the blood unabsorbed for an indefinite time. In the first case, the tumour must be opened and drained like any other abscess; in the second, when patience has fairly been exhausted, and it is plain that absorption is not going to take place, the fluid must be removed. Sometimes, aspiration, or the use of a small trocar and cannula will be sufficient to empty the sac, but in most cases it will have to be laid more freely open, and the contents turned out; the operation should be performed antiseptically, and the cavity thoroughly drained, while there should always be pressure put upon its walls to prevent a fresh filling up.

Lastly, as in the case of a diffused ecchymosis, sometimes but very rarely, the tension on the tissues bounding a hæmatoma may be so great that it must be relieved by incision. This procedure should be delayed as long as possible but if it must be done it should be with the strictest antiseptic precautions.

Special bruises. Hæmatoma of the scalp.

Special bruises. First among these may be mentioned hæmatoma of the scalp, generally occurring in newly born infants, as one of the accidents of labour, but also as a complication of fractures and other injuries to the head. Unless actual death of the skull bone takes place, the blood is invariably re-absorbed, and incision is never required. The peculiarly deceptive feeling as of a depressed fracture has already been alluded to.

Sub-conjunctival ecchymosis.

Sub-conjunctival ecchymosis is sometimes of importance as a diagnostic sign in suspected fracture of the anterior fossa of the base of the skull, but it commonly occurs almost spontaneously, as during a paroxysm of whooping cough. It should always be left alone, as it is never in itself a matter of importance, and is generally soon absorbed.

"Black eye."

So, too, with the ordinary "black eye," when the extravasation has once taken place, no application will affect the rainbow-like hues of the discoloration, or make them disappear quicker than in their own good time. But the early application of cold, as by an ice bag or an evaporating lotion, or of astringents, and especially of the acetate of lead, may do a good deal to limit the actual escape of blood and serum.

Hæmatocele.

Hæmatocele should also be mentioned as being an extravasation of blood into a natural cavity. Whether it occurs spontaneously or in consequence of a blow, its treatment does not differ from that of other hæmatomata. Elevation of the scrotum, cold, and carefully managed compression (see strapping the testicle, p. 121), will powerfully aid the absorption of the effused blood, and if these measures should fail, the cavity of the tunica vaginalis must be opened. If there be reason to believe that its contents are chiefly fluid, a hydrocele trocar may be used (see treatment of hydrocele), but if the clotted blood cannot thus be removed the cavity must be laid open and allowed to granulate up.*

Frostbite.

Frostbite. A few cases of this injury occur in this country whenever it is visited by severe weather, generally in ill-fed, ill-clad people, whose circulation is enfeebled by privation or organic disease, and although it is in no sense a bruise it may here be shortly considered. The main point to recollect about this form of gangrene is, that the tissue dies, not when it is frozen, but when it thaws, in consequence of the intense capillary congestion then set up. In countries where the accident is common this is well known, and when any part, as the nose or tip of the ear, becomes dead white and loses its sensibility, the custom is to rub it for a long time, but not too vigorously, with handfuls of snow. Following the same principle, great care must be taken not to thaw the frozen part too quickly. The patient should be kept in a cold room, and bathed first with cold water, and then gently rubbed with the hand till circulation begins to be restored, when there will be much throbbing and feeling of heat, and the extent of the mischief will be disclosed. At no time must heat be applied, but the part should be wrapped up in cotton wool.

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* This proceeding is however an operation belonging rather to the major ones of surgery. In other cases it happens that a condition resembling chronic hydrocele develops after the tapping of a hæmatocele, and the accumulation of the thin serous fluid may be successfully treated by measures similar to those adopted for the radical cure of that condition (*q.v.*).

Frostbite from ether spray. Sometimes a frostbite is produced by the prolonged application of the ether spray, especially if the parts frozen are already in a state of inflammation, and even an ice-bag, **Sloughing from ice-bags.** if left on for too long, may produce sloughing. Thus we have known such a bag, left on a hernia for a night, produce extensive destruction by the morning.

CHAPTER XIX.

OF ULCERS, ESPECIALLY ULCERS OF THE LEG.—OF VENEREAL SORES, AND SYPHILITIC ULCERATIONS.

Dressing of ulcers.

Of Ulcers. Every surface wound which is granulating is in a sense, an ulcer, and what we have previously stated as to the dressing of wounds when the granulation process has once started, will stand equally for that of any healing ulcer, however produced.

Of healthy ulcers.

It is difficult to prevent a healthy sore from closing over rapidly, and almost any cleanly form of dressing will serve well enough; still discretion may be exercised.

Simple cerate, or zinc ointment, will generally be best for small surfaces; lint soaked in carbolised oil, or in carbolic acid, or in some other lotion for large ones. Sometimes under the oil the granulations will get large and flabby, and an astringent dressing, as of zinc sulphate or silver nitrate, is called for. Sometimes the edges require to be touched with caustic, or with a crystal of sulphate of copper (bluestone) and so on.

The dressing of healthy ulcers, then, presents little difficulty or occasion for remark. On the other hand the difficulty of getting an unhealthy sore to change its character and take on healing action is often very great indeed, and some of the ways of attempting this we must shortly discuss.

It would plainly be useless to try to describe all the kinds of unhealthy ulcers which may be formed in the various parts of the body, nor need we adopt any especial plan for their classification. The various plans of dressings which may be resorted to will be sufficiently described if we take two great examples of ulceration for our consideration, namely ulcerated legs, and syphilitic sores.

Ulcers of the legs.

Ulcers of the leg.

These are the bane of all out-patient rooms, where those who suffer from them form at once the most numerous and the most unsatisfactory class of patients to treat. With the exception of those which depend on some specific taint, or which are the direct result of injury, it may be said that they are all the result of an imperfect return of the blood from the extremities, either due to varicosity of the veins, to simple malnutrition of the tissues, to feebleness of the general circulation, or all of these circumstances combined.

Treatment of the venous stagnation. The treatment must therefore be directed in the first place towards this condition of venous stagnation, and secondly, towards the improvement of the surface of the sore.

By rest in bed. Nothing so well fulfils the first indication, as complete rest in bed, with the limb somewhat raised, and in the large majority of cases this treatment alone would be sufficient to effect a rapid healing, if only it were possible to carry it out. But too often for these patients, to lie in bed would be to starve, and so other means must be resorted to, and the chief of these are, even bandaging, elastic stockings, Martin's rubber bandage, and strapping.

By bandaging. Much may be done to prevent the stasis of blood and œdema by means of a firm even roller, applied to the legs as in Fig. 47. The bandage should include the foot, but not the heel, and should be put on every morning before the limb is allowed to hang down, and if the material possess some elasticity, as in the woven or elastic felt kinds, so much the better.

By elastic stockings. For obvious reasons it is hardly possible to apply elastic stockings to legs in which the ulcers are large or discharging at all freely; but if this be not the case, a properly fitting stocking often gives an immense relief from pain, and may prove a direct means of cure. The objections inherent to their use mentioned before apply equally in these cases.

By Martin's bandages. Probably few improvements in surgery have been the direct cause of relieving suffering, more than the introduction by Dr. Martin of thin indiarubber roller bandages for the treatment of this condition. These have been before mentioned as being useful in a variety of ways, but it is in painful ulcers of the legs that their good effect is especially apparent. As a rule, they should not be worn in bed, but should be applied like other bandages before the legs hang down in the morning. The bandages must be protected from the discharges by pads of dry lint or cotton wool, and care must be taken that they are not put on too tightly, which may very easily happen from their great elasticity.*

By strapping. The introduction of Martin's bandages will probably cause the proceeding of *strapping ulcers*, to be less frequently resorted to than formerly, but still in proper cases it is a very valuable treatment. Its principle is the same as the foregoing, namely, of giving support and pressure.

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* For a full account of these bandages, see *British Medical Journal*, 1878, Vol. II., pp. 624 and 874.

Ordinary adhesive plaster, spread on linen or leather, is generally used; the surface of the ulcer should be covered with a piece of moist boracic lint. The strapping should be cut into strips about an inch wide, and these must be applied so that they overlap each other, as is described for the strapping of the knee (Fig. 80). The strips should begin at least two inches below the ulcer, and end at least two inches above it. Over the strapping the foot and leg should be firmly bandaged.

If this treatment can be borne at all, the relief afforded by the support is very great, but sometimes the veins are extremely varicose and thin walled, and the ulcerated surface is too tender to bear direct pressure. In such cases it is often wise to apply a strip, three inches broad, round the leg, above the ulcer, to support the column of blood in the dilated veins.

Operations for the radical cure of varicose veins are often wisely undertaken in cases of ulcerated legs arising from this cause, but the consideration of these proceedings does not come within the scope of this work.

Local treatment of the ulcerated surface.

Very much may be done locally to promote the healing of these ulcers, and successfully, provided the venous stagnation, which is their real cause, be first alleviated. Much, too, may be done by proper feeding, and sometimes by medicines, to improve the nutrition of the tissues.

The nature of the dressing which will best suit any particular ulcer will depend upon the character of the sore; whether it be hæmorrhagic, neuralgic, inflamed, and so on, so that no one line of treatment can be laid down as generally applicable.

We propose here to give examples of what may be done for the chief kinds of ulcers met with in the outpatient room, it being understood that the dressings are *examples* only.

Common chronic ulcers.

By "common chronic" ulcers we mean those in which the edges and discharge are fairly healthy and in which granulations are present. There is little difficulty in getting these to heal if the venous stagnation be prevented. Ointments, such as vaseline, zinc ointment, ung. hydrarg. nitroxidi, diluted with lard or vaseline, or carbolised, or eucalyptus oil, and many other dressings may be used. All these dressings should be changed frequently, and the sore kept very clean, weak carbolic or Condy being used for washing.

"Cold" ulcers.

Almost the most hopeless kind of ulceration is that irregular, shallow, pale, dry form, known as a "cold" ulcer.

Blistering.

Caustics.

Warmth.

They are generally large, quite devoid of granulations, insensitive to touch, with little or no discharge or evidence of inflammation. It is this last fact that tempts the surgeon to despair, and unless the surface of the ulcer can in some way be stirred into action, no healing can take place. To this end it was an old practice to apply a blister over the whole surface, and although this remedy is now old fashioned, it might well be revived in suitable cases. A solution of chloride of zinc (40 grains to the ℥j), or of nitrate of silver (from 10 to 20 grains to the ℥j), or the solid lunar caustic, are the stimulants most commonly used. When the ulcer has once been roused into action and granulation has commenced, the process must be maintained by milder stimulating dressings, as the Friar's balsam, the balsam of Peru, the ung. hydrarg. nitroxidi dil., the diluted tincture of iodine, or by one of the astringent lotions as that of the sulphate of zinc or copper. It is especially important that the ulcer and the limb should be kept warm. This is best effected by cotton wool; occasionally a very hot linseed poultice, to which a little mustard flour may be added, will prove a very useful stimulant. It is in this form of ulcer that strapping is most beneficial.

Flabby ulcers.

May be treated like cold ones.

Allied to the "cold" ulcers are those which are not devoid of granulations or action, but in which the whole process of ulceration or repair is weak. They may spread to a large size, with pale flabby granulations, a watery discharge, and very frequently with their edges extensively undermined. These also must be stirred into action, and this can generally be done somewhat more readily than in the case of the cold ones, by the use of similar stimulant dressings.

Use of sheet-lead.

In addition to the dressings, however, it is necessary here to trim off the undermined edges with scissors, and if the granulations are very flabby, it is wise to get rid of them altogether by scraping the surface of the ulcer, and thus starting afresh. Sometimes a very useful stimulus is given to these sores by covering them with a piece of sheet lead, such as is used for packing tea, cut out to the right size. A rather active chemical action is set up, and the metal is quickly eroded, the stimulating effect being probably due to the action of lead sulphide in the nascent state, upon the surface of the sore.

Inflamed ulcers.

An inflamed ulcer is always a spreading one, and on that account alone the process should be cut short as quickly as possible. Their sharp cut, angry edges, painfulness, and dirty discharge, make a mistake in their diagnosis almost impossible. Confinement to bed is now, not desirable only, but necessary. The limb must *always* be raised, and irrigation (see Fig. 132) is probably the best of all dressings. Water dressing (weak carbolic acid or Condy being used) and poultices are also very useful. These ulcers are generally foul, and pass by insensible gradations into the kind next to be considered.

Sloughing or foetid ulcers.

That worst kind of sloughing ulcer, sloughing phagedæna, will be considered later, but any ulcer may, under certain conditions, take on a sloughing action. Sometimes the rate and character of the destruction are so rapid, that it is advisable to cut it short by the application of nitric acid, or the actual cautery (see Sloughing Phagedæna). As rule, however, it is sufficient to treat the case as one of severe inflamed ulcer, with the addition of those measures rendered necessary by its fœtid character. Charcoal, or sometimes yeast poultices are generally preferable to irrigation, at any rate, at first. The limb may be kept in a bath of Condy or carbolic acid for an hour or two, and in any case these lotions, or the lotion of chlorinated soda or the like must be very freely used. Terebene and "Sanitas" are also good applications, as is also iodoform in certain cases.

Hæmorrhagic ulcers.

The management of those ulcers, the granulations of which have a marked tendency to bleed, has been already discussed (p. 44), and need not be further considered. This is the case too, with those which erode the walls of varicose veins (see p. 32).

Neuralgic ulcers.

Pain is not usually a prominent symptom in ulcers on the legs, but sometimes they entail an inordinate amount of suffering. These neuralgic ulcers are generally small, with small granulations. The relief of the pain they cause is often very difficult, and sometimes almost hopeless. Of local anodynes, the most generally successful is a concentrated carbolised oil, say, 1 in 20 to 1 in 12, or the glycerine of carbolic acid may be used, or the same acid, pure. A lotion of the nitrate of silver, grs. v—℥j is also often effective, as is sometimes the solid lunar caustic.

Anodynes.

In other cases opium, or its alkaloid may be used in the form of poppyhead fomentations, or the powdered crude opium may be dusted over the sore. Care must be exercised in this case that only a limited quantity is used, or poisonous symptoms may develop from absorption.*

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* It is perhaps more correct to say that these cases should always be watched, for it seems that there exists in some people a susceptibility to opium poisoning by the local absorption of even very small doses.

Solutions of cocaine, morphia and chloral may also be used as local applications, on lint, or in the form of the hand spray. Preparations of belladonna are also sometimes of service.

Iodoform is frequently of service in alleviating the pain of simple ulcers, as it is to a more marked extent in the specific forms (*q.v.*).

Division of nerve.

If the pain can be distinctly localized to one spot, it is probably seated in one nerve filament. The late Mr. Hilton has shown that it may be quite abolished by making an incision through the granulations, so as to divide the nerve thread, and these are the most fortunate of all cases for treatment.* In other cases the pain is due to a general neuralgic tendency, and these may be benefited by constitutional treatment, such as quinine, iron, etc. Lastly, the pain of a neuralgic ulcer may often be relieved by moderately firm pressure. Thus strapping, or Martin's bandage, are appropriate modes of treatment for these as for other forms of ulcers. The elastic compression exercised by a sponge bandaged or strapped over the granulations has been recommended.

Pressure.

Of certain special treatments.

The following lines of treatment have all had more or less success in fitting cases, but we here rather mention than advocate them.

Electricity.

The electrolytic effects of a weak galvanic current have certainly a stimulating action on chronic ulcers, but the application is not very easy, and the same good results may probably all be attained in more convenient ways. The current might be applied direct from an ordinary galvanic battery, as from two pint Leclanché cells, one electrode being placed a little distance from the ulcer, while the other (which is best fashioned out of a piece of sheet zinc or lead) should be placed over it. The current should be maintained for several hours.

Another way is to connect two plates of zinc and silver by a piece of insulated wire, and to apply the zinc *or* the silver plate† over the ulcer, and the other one elsewhere, say on the opposite side of the leg, or on another ulcer, if more than one exists.

Incision.

Incisions made through the *margins* of the ulcer into the subcutaneous tissue have been advised. Their good effects are probably due to the alteration of the vascular and nervous supply thus caused. Again, incisions, crucial or multiple, are sometimes made through the *bases* of cold ulcers, especially of those which are adherent by inflammatory exudation to the underlying tissues.*

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* This will be again alluded to *apropos* the treatment of painful ulcer or fissure of the anus.

† Authorities differ as to whether the positive or the negative pole is the more efficient.

Excision. *Excision* of the whole ulcerated surface, with or without attempting to close the edges of the wound thus formed, is a rational and often successful treatment for very severe and obstinate cases.

Cautery. *Both the actual and the galvanic cautery* have been employed on the same principle as the application of a blister or lunar caustic, namely, in order to start afresh, and it is hoped, with more healthy granulation tissue, after the sloughs caused by the cautery have separated.

Continuous bath. In addition to the occasional use of a carbolic or Condy bath, the limb may be *submerged continuously* for days (Hutchinson). This treatment will be referred to again under the head of "sloughing phagedæna."

"Sealing." Ulcers may also be "sealed" by covering them over with white wax, or lastly, for deeply excavated indolent ulcers, the cavity may be filled up with the powdered carbonate of iron, and the whole strapped up.

Doubts have been expressed as to the wisdom of healing old chronic ulcers of the leg of many years' standing; it has been suggested that they sometimes acquire a certain status among the secreting or excreting organs of the body, a respectability, as it were, and that though their presence may be a discomfort, their departure would be a disaster, from the extra work which would then be thrown on other organs, chiefly, we suppose, upon the kidneys.

We will not venture upon a positive denial of this somewhat bizarre theory, but we believe that any ulcer which can be made to heal should be encouraged so to do.

The question of skin and sponge-grafting will be considered in the next section under "Burns and Scalds;" but it may here be said that in any form of ulcer, skin grafting can never be successful unless the surface of the sore be covered with healthy granulations.

OF THE DRESSING OF VENEREAL SORES, ETC.

Syphilitic sores. We here consider the chief ways of dressing the initial lesion of syphilis, *i.e.*, the true syphilitic or infecting sore, as it most commonly presents itself, the later syphilitic ulcerations, and the common soft, non-infecting, or suppurative sore, often called chancroid. The treatment of constitutional syphilis does not come within our scope any more than that of any other of the exanthemata.

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* See "Clinical Lecture on Adherent Ulcers," by Mr. Hardie, *Lancet*, May 17, 1884.

Excision, etc. The question of early excision or cauterization of the initial sore, can hardly be more than alluded to. There is the high authority of Mr. Hutchinson and of most French authors for its performance, if it seems possible (and certainly it ought to be so sometimes), to prevent lymphatic absorption, while on the other hand, such authorities as Berkeley Hill and Cooper consider that the evidence of this possibility is very doubtful.*

It may, at any rate, be said that if an abrasion be detected within a few hours of an impure connection, it will be quite justifiable to cauterize with fuming nitric acid, or with Ricord's paste (acid. sulph. fort. and charcoal, *q.s.*), or with the Pacquelin's, or the actual cautery.

Excision, unless a large wound be made, can do no more than the acid or the cautery, and is in other ways very objectionable, while from the milder caustics, such as the nitrate of silver, no efficient protection can be expected.

But in the vast majority of cases, the time for any attempt to confine the sore to its local action has long since passed by when attention is seriously attracted to it.

Local treatment of the true syphilitic sore. The local dressing of the ordinary infecting sore which runs its course without complications, is generally simple enough. The sore itself, and the surrounding parts must be kept scrupulously clean, bathed several times a day, and unless the foreskin be very short, it will be wise in all cases to keep a piece of lint between it and the balanus. For the sore itself, black-wash, iodoform, and yellow-wash stand before all other preparations, and any one of the three is suitable for most cases.

Black-wash. The *black-wash* (lotio nigra, lot. hydrarg. suboxid.), prepared by adding 15 grains of calomel to 5 oz. of lime water, may be used to wash the sore; also the dressing may consist of a piece of lint soaked in the lotion, and covered if necessary with gutta-percha tissue. The mercurial suboxide is very heavy, and it is better to add some mucilage to the lotion so as to suspend the powder as much as possible.

Iodoform. *Iodoform.* This is one of the most useful of all local dressings, and the way in which specific sores take on a healing action under it, is very striking. Unfortunately its strong and unmistakable odour is very difficult to hide, and one practical drawback to its employment is that the significance of its smell is now getting to be recognised by the public, so that patients naturally object to the risk of detection.

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* See "Syphilis," 2nd Ed., 1881, p. 76.

Iodoform may be used in the form of a very fine powder (the common samples are too coarse) simply dusted upon the sore. This is a very good way if the ulcer be a small one, and especially if it be well covered by the foreskin. The smallest possible quantity should be taken up with a quill and applied, great care being taken not to scatter even a grain about. The powder is not so apt to scatter if the neighbouring parts have been smeared with vaseline or zinc ointment.

Another good way of using the drug is as an ointment, mixed with vaseline in various proportions, from 20 to 60 grs. to the ℥j, or as a paste (Gerrard),* which can be moulded into a wafer form with the fingers or with a piece of wood. It may also be used in the form of a liniment, made by adding 1 ounce of the oil of eucalyptus and 5 ounces of olive oil to 1½ drms. of the iodoform powder.

Lastly, it is soluble in ether, and thus will dry as a thin pellicle over the surface of the sore, if an ethereal solution be painted on it.

Yellow wash. *The yellow wash* (lotio flava, lot. hydrarg. perox.), is used precisely as the black wash, but is more actively stimulant.

As soon as the surface of the sore has lost its specific character, and is beginning to granulate, a weak stimulating lotion, as that of the sulphate of zinc, or of the subacetate of lead, zinc ointment, or some other simple dressing will be all that is required. The induration must not be expected to disappear for some time after the surface is healed.

Suppurating venereal sores. In feeble constitutions, or through neglect of cleanliness, infecting or true syphilitic sores may become freely suppurating ulcers with more or less loss of tissue. The requisite dressings for the sore in this state do not differ from those of the non-infecting chancre, which is usually a simple suppurating sore, but which may become an ulcer

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* Iodoform paste :—

Iodoform	ʒj	Mix.
Wood charcoal	ʒij	
Glycerine of starch	ʒij	
Glycerine	℥j	
Oil of lavender	♏xx	

with well marked loss of substance, or, in extreme cases, may run on into sloughing phagedæna.

Their dressing.

The best treatment at first for any suppurating sore, whether infective or not, in the absence of deep ulceration, is the ordinary water dressing, changed every few hours. If there be any foulness, Condy's fluid or weak carbolic acid should be substituted for the water. Under this dressing the sore, if it be a simple one, will soon subside and take on a healing action, or, if infecting, will soon manifest the characteristic Hunterian induration. For all specific sores, the solution of tartarated iron (about grs. x to ʒj of water) forms a very good application, except in the early stages of the ordinary infecting sore. It may be used for the common suppurating soft sore at any time, and is believed by many to suit these better than lotio nigra, or iodoform.

Suppurative sores with loss of substance.

If the ulceration be deep, the patient should be kept in bed, and (in the case of male patients) the penis should be supported. Frequent warm fomentations and poultices are often found to be better than water dressings. Iodoform is useful also in this condition; it may be dusted on the ulcer, and a poultice placed over all.

Venereal sores may become phagedænic.

The destructive course of *true sloughing phagedæna* is seen nowhere more strikingly than in the genital organs, both male and female. In broken down constitutions, or in patients profoundly unhealthy, any venereal sore may take on a sloughing action, which once set up, seems to run riot in the loose tissues of these parts.

Often require cauterization.

It is essential to arrest this destructive inflammation as soon as possible, and if absolute rest, fomentations, and poultices fail to do so, it is best to lose no time, but at once to apply the fuming nitric acid, or the thermo-cautery, or Ricord's paste, to the edges and base of the ulcer. A charcoal or yeast poultice should then be applied, and the parts bathed constantly with Condy, carbolic, or chlorinated soda lotions.

In very severe cases, and sometimes the destruction is very wide spread, the continuous bath advocated by Mr. Hutchinson produces very striking effects.

Constitutional treatment.

In all these cases a generous diet, and stimulant treatment will be required. Preparations of quinine, or the liquid extract of bark, carbonate of ammonia, and chlorate of potash, are the chief drugs employed; alcohol will probably have to be given in full quantities.

Local dressing during healing.

As soon as the excavated ulcer begins to clean, and the sloughs to separate, iodoform, or the solution of tartarated iron, or of boracic acid, are often very useful applications; but, speaking generally, any weak stimulating lotion will do for the dressing. At this time the possibility of hæmorrhage from eroded vessels must be kept in view. This may occur anywhere if the destruction has been deep, but is more frequent when the phagedænic action has extended to, or has occurred in the glands of the groin or their neighbourhood (virulent bubo).

Risk of hæmorrhage.

All that has been said as to the dressing of these specific sores applies equally whether they occur in men or women, save that in the latter the dressing is generally more difficult to manage, and that indolent infective sores, when they occur high up in the vagina, are very apt to be overlooked.

Later syphilitic ulcers.

The ulcers which result from the breaking down of syphilitic deposits in the skin or the tissues beneath, or as the result of other specific inflammatory processes, only differ from ordinary ulcers in their dressing in one or two points, and it is only with their dressing that we have here to do.

Must lose their specific character before they can heal.

The surgeon's efforts are in all cases directed towards the disappearance of those peculiar characteristics which cause these ulcers to be called *specific*. When once these are lost, and the sore assumes an ordinary appearance, it rapidly heals.

The fœtor, the sharp cut edges, the dirty base, and the sanious discharge, must be replaced by healthy granulations, bevelled off edges, and the secretion of laudable pus; and to effect this, in all cases constitutional as well as local treatment is called for. It is this that makes it so necessary to recognise these ulcers. Nothing is more common than to see some obstinate ulceration baffle for months or years all efforts to heal it over, and then to find it disappearing from day to day, almost from hour to hour, as soon as full doses of iodide of potassium are administered.

On the other hand, although attention must be given to the condition of the circulation in the part, this is not so urgently demanded as in the case of simple ulcers.

The first importance of constitutional treatment being understood, by proper local dressing the rate of healing may be greatly increased.

So long as the sore has any specific character, so long must the dressings be anti-syphilitic. The preparations of iodoform, black wash, various mercurial ointments, especially the ung. hydrarg. oxid. rub., calomel and vaseline, or the ung. hyd. subchlor. may all be used with advantage, with many more. The acid nitrate, or the bicyanide of mercury may be used as a caustic for warts, fissures, or mucous tubercles, as in the mouth; as may also be the mercuric perchloride in a strong solution (say 24 grs. to ℥j).

In the formulary at the end of this book will be found the composition of the chief mercurial, and other anti-syphilitic applications in common use.

CHAPTER XX.

OF CERTAIN SPECIAL INFLAMMATIONS.

IN this chapter we propose to review in the first place the chief points which arise in connection with the dressing of parts affected with any of the various forms of erysipelatous inflammation. We shall then discuss the management of boils and carbuncles, and the ways in which "bedsores" may be prevented, and how they should be treated when they have occurred. Lastly, we shall consider the treatment of the condition which is known by the name of sloughing phagedæna, or hospital gangrene.

Of cutaneous erysipelas.

Cutaneous erysipelas. Local applications.

The local applications in the cutaneous forms of erysipelas are directed towards limiting the extent of the inflammation, or diminishing the tension of the skin.

Fomentations, poultices, powders. **Collodion.**

Fomentations and poultices of various kinds, or the powder of starch, flour, or zinc oxide, are the applications most commonly used. In early and slight cases, *collodion* painted on the part sometimes answers very well, but the belief that the spread of the area of inflammation may be checked by a line of nitrate of silver painted round the margin, seems to be fallacious.

Acetate of lead.

The preparations of lead, especially of the acetate, are very useful, either in the form of the ordinary "lotio plumbi," or in a more concentrated solution, say ʒj—ʒij liq. plumbi subacet. fort., to ℥j of water.

White lead paint.

Another preparation of lead has lately been strongly advocated, and with good reason, namely *white lead paint* as ordinarily used by house-painters. This is no doubt chiefly an oleate of lead,* but it certainly seems as if in many cases it exerted a specific influence on the inflammation. The paint is simply laid on with a brush, and the parts covered with cotton wool.

Punctures.

In cutaneous erysipelas large incisions are never called for, but it is often wise to promote the escape of serum and to relieve the tension of the cuticle by numerous small punctures, or "stabs," with the point of a sharp scalpel. This is especially the case in situations where the cellular tissue is loose, as in the eyelids.

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* A "linimentum plumbi sublactatis" is prepared by Messrs. Wilson & Co, and appears to have the same action as the paint.

Phlegmonous erysipelas. Value of incisions.

In phlegmonous erysipelas, or in *cellulitis*, on the contrary the value of *incisions* made freely and early in the course of the inflammation, is perhaps the most important point to bear in mind in the surgical management of the case. Whenever there is brawny tension, and still more, whenever there is any "boggy" feeling, incisions extending into the cellular tissue beneath the skin should be promptly made, and will afford great relief. The bleeding from them is generally free at first, unless the parts are already sloughing, and should not be immediately checked. If it does not stop of itself in a short time, a little pressure is all that will be necessary.

Poultices and other dressings.

Poultices will, as a rule, be found the best application for these forms of erysipelas; but irrigation and immersion in baths of Condy, or of carbolic lotion, are also very useful, and in all cases the inflamed parts should be raised if possible.

Constitutional treatment. **Bark and iron.** **Stimulants.**

The reader may be reminded of the importance of constitutional treatment in all these diffuse inflammations, and especially of the usefulness of the preparations of bark and iron; and of stimulant drugs, such as the carbonate of ammonia. Alcohol, too, will generally be required, and opium in some form or other may be indicated.

Sloughing phagedæna.

Reference has been made at different times to that peculiarly destructive and rapidly spreading ulcerative inflammation known by the name of *sloughing phagedæna*, or *hospital gangrene*.

This condition is now much less frequently met with than it was even a few years ago, but when it shows itself it must be dealt with promptly, for unless checked in its course it will not spare blood vessels or any other tissues.

Cauterization, Method of.

In some few cases, cleanliness and constitutional treatment are sufficient for its arrest, but very frequently it is necessary to use some form of cautery, or caustic, and of these the actual cautery, and the fuming nitric acid are the best.

The latter is most conveniently applied with a small mop of cotton wool, twisted round a splinter of wood. The sloughs themselves should be first cut away (not pulled) as nearly as may be down to the line of the spreading inflammation, and then the whole space or cavity thus formed should be mopped out with the acid, or seared over with the thermo-cautery of Pacquelin. If this treatment is successful, it will be seen that the sharp cut edges of the ulceration no longer spread from hour to hour, but gradually lose their angry look, and take on a healing action under the sloughs produced by the cautery.

To forward the separation of these sloughs, and to prevent fœtor, charcoal, in powder or as a poultice, or linseed or yeast poultices are the most usual dressings, with frequent fomentations of warm Condy, or carbolic lotions; but another very important line of treatment must not be omitted—that advocated by Mr. Hutchinson* and others, of immersing the patient in a bath for many hours continuously. The temperature must of course be kept up to about that of the body, and under these conditions it is certain that the spread of inflammation has been arrested in extremely formidable cases, where all other methods of treatment have failed.

Continuous immersion.

As soon as the ulceration begins to take on a more healthy action, some more stimulant form of dressing will be found useful in the place of the poultices, such as the balsam of Peru, or Friar's balsam, terebene, eucalyptus oil, etc. Iodoform, in powder, or as an ointment is a most valuable application in any of the stages of the inflammation.

In England, at the present time, examples of true sloughing phagedæna are rarely met with except in connection with syphilis, in the form that is, of syphilitic ulcerations which take on this destructive action in consequence of the miserable state of nutrition of the patient. In these cases then, the diet must be a generous one, and stimulants will be required in full doses. Opium also is very valuable.

Generally met with in syphilitic cases.

A special kind of phagedænic ulceration is known as *noma*, or when it occurs, as is usual, about the mouth, *cancrum oris*. In its pathology it appears to be almost identical with sloughing phagedæna, as it is in its treatment. It is especially a disease of children, and is characterised by the peculiar dryness of the slough, which looks more like an eschar, and by the rapidity of its destruction. It is often almost painless, and may be accompanied by singularly little constitutional disturbance until quite late in the progress of the case.†

Noma, or cancrum oris.

It is frequently a sequel of diphtheria, scarlatina, etc., but it seems as often to attack children to all appearance healthy and well-nourished, as those who show signs of malnutrition.

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* *Medical Times and Gazette*, 1862, Vol. I., p. 8.

† This, the true "cancrum oris," must not be confounded with that common ulceration of the mucous membrane of the mouth, which is frequently met with in ill-nourished children.

Mode of commencement. Whenever there appears, in children, in the substance of the cheeks, or on the vulva, a dusky induration, with a dry central slough, the case should be looked upon with suspicion, and if it shows any tendency to spread, there is no question but that the right course is to remove the gangrenous tissue at once, and to apply nitric acid, or some other form of cautery, freely. **Its arrest.**

Importance of frequent washing, etc. One common cause of death in these cases is the poisonous effect of the putrid discharges when these have been swallowed. It is impossible to prevent this altogether, but very much may be done by extremely frequent washing out with such lotions as the chlorate of potash, chlorinated soda, or of dilute liq. chlori. Chlorate of potash should also be freely given internally.*

Passing over the rare forms of gangrenous inflammation, malignant pustule, malignant facial erysipelas, or facial carbuncle, etc., a word or two may be said as to the dressing of boils and carbuncles.

Of boils. When a boil is seen early, and especially if it be of the "blind" variety, attempts may very properly be made to abort the process of its maturation. **Their abortion.** A pointed stick of lunar caustic may be held against its centre for about a minute, and the injection of one or two drops of pure carbolic acid into the centre of the inflammation by means of a hypodermic syringe is stated to be very successful. In the majority of cases, however, a boil once started will run its course, and all that can be done is to hasten its maturation. **Their dressing.** Poultices and water dressings do not appear to suit this kind of inflammation so well as they do most others. Boils seem to do best when they are merely protected from pressure, and perhaps the best dressing for them is the opium plaster (E. opii), spread upon a piece of soft chamois leather, in the centre of which a small hole may be cut.

When suppuration has evidently occurred, a crucial incision followed by warm fomentations, will hasten the separation of the central slough or "core."

Of carbuncles. The practical questions which arise in the dressing of carbuncles are, first, whether or no the inflamed part should be incised, and secondly, the consideration of the best external application during the first stages of brawny induration, and in the later ones of separation of the sloughs.

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* Or any of the sprays which are so useful in diphtheritic cases, as of the boracic, or sulphurous acids, or of sanitas, may be employed.

Of their incision.

Authorities differ widely as to the theoretical wisdom of incising carbuncles, but there can be no doubt that the practice is far less general than it used to be.

The question probably resolves itself into one of tension. In carbuncular inflammations, as elsewhere, if the local tension is itself strangulating the tissues and shortening their life, this ought to be relieved by incision, and tissues may in this way be saved which would otherwise die. On the other hand a routine slicing into every carbuncle would be only a needless cruelty.

If incisions are decided on they should be made sufficient once for all for the relief, for few things are more trying to patients than the daily repetition of such operations.

Method of its performance.

The common plan is to make bold crucial cuts right through the inflamed mass, down to its base. Another way is to make the incisions subcutaneously, slipping a long narrow bladed knife into the base of the carbuncle, and severing its connection with subjacent parts, and then dividing or quartering without further injury to the skin.*

With regard to the dressing, at first, poultices or water dressings, with frequent fomentations, will be best; later, when the sloughs are separating, and the suppuration is fully established, some of the stimulant resins, such as Friar's balsam, balsam of Peru, terebene, etc., will hasten the process.

Excision.

But septic absorption may take place and death from septicæmia or pyæmia, and this is a strong argument in favour of a more radical treatment, such as excision of the carbuncle. If the patient be placed under an anæsthetic and the diseased tissues be removed by scraping with a Volkmann's spoon and the indurated skin cut away, a wound will be left which will speedily become covered with healthy granulations, and healing take place in a much shorter time than would have been the case if the sloughs had been allowed to separate. This method also cuts short the severe pain which is so prominent a symptom in carbuncle.

Constitutional treatment.

Carbuncles so frequently occur in persons who are broken down constitutionally, that these cases often require very careful and generous general treatment. An especial examination should always be made to ascertain if sugar be present in the urine. The same precaution should be taken in cases of obstinate and successive crops of boils.

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* The hæmorrhage from these incisions is sometimes very profuse, and may be a source of danger in patients who are already much enfeebled.

Urine to be examined.

Of bed-sores.

Experience alone as to what bed-sores may become if neglected will enable the student to realise the extraordinary amount of destruction which this form of ulceration from pressure can cause, or the rapidity with which it spreads, or the insidiousness of its commencement. It is also very necessary for every surgeon and every nurse to understand that with the exception of certain paralytic cases, bed-sores are almost always preventable, and, when present, are as a rule, standing evidence of neglect or mismanagement. But, though we will not qualify this assertion further, it must be allowed that sometimes it is extremely hard to prevent soreness, as, for example, in a case of hip disease with extreme emaciation, contraction of both legs, and suppuration. Sometimes, again, tissues have such a low vitality that it seems as if the least touch would produce a slough; still with incessant watchfulness, with the exception of the paralytic cases we have mentioned, bed-sores *can* be prevented, although once begun they are very hard indeed to arrest or to heal

How best guarded against.

In warding off the formation of bed-sores, attention must be specially directed to the following points:—

The bed.

I. The bed must, in all cases, be smoothly made, elastic, and soft; a spring mattress is often a great help, and water cushions may be used for the buttocks, etc. But in cases where there is a well marked tendency to soreness there is nothing like a complete water bed.* In filling one of these beds, care must be taken to have the water properly warmed, and not to put in more than will just support the patient.

Change of position.

II. In every possible way *continuous pressure must be avoided* upon the parts which are liable to become sore, such as the sacrum, trochanters, ischial tuberosities, heels, occiput, elbows, or the spines of the scapulæ. Taking every precaution (when precaution is needed, as in fractures) against doing local harm by movement, in some way or other it must be managed that the patient shall shift his points of pressure upon the bed, lying now a little low, now a little high; first with the head to one side, next day turned slightly over (for the least shift is as efficient as a great one) to the other; a pillow may be put under the knees one day and omitted the next, etc.

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* In private nursing it is well to recollect that these can be hired.

Local applications.

III. Something may be done to improve the nutrition of the skin by bathing with stimulant lotions (whiskey, or brandy and water is a common application). Starch or violet powder should be freely used, and if the tendency to soreness appears imminent, the part, which will be a bony prominence, should be covered with a protective adhesive plaster spread upon chamois leather or felt.

Nowadays in hospitals or where skilled nursing has been employed from the first, such precautions as we have mentioned will be sufficient to prevent soreness altogether, or at the worst to limit it to a superficial excoriation. The cases we meet with where true ulceration is present, are those where there has been previous neglect of nursing care, through ignorance or poverty.

Modes of dressing when already formed

Such cases are not infrequent among those who come at last to be hospital in-patients, and whatever the nature of the original illness may be, the bedsores will count heavily against recovery. These ulcerations are indeed very hard to dress; they present the characters of deep foul sloughing ulcers, not generally painful, but tending to destroy all the soft parts between the skin and the bone, and often complicated by necrosis of the bone itself. The great point then is to remove all pressure, and to get the ulcer to begin to clean.

Charcoal, or yeast poultices, with frequent fomentations, and if possible, immersion in baths of warm Condy or carbolic lotions will be the best treatment at first, and after wards when the sloughs clean off, stimulant resins, such as tinctura benzoinæ co., balsam of Peru, etc., will suit well.

Very much will depend upon whether there is improvement of the constitutional condition, or the reverse. If there be general recovery, local recovery is often extremely rapid when once it is started.

CHAPTER XXI.

BURNS AND SCALDS.

Burns and scalds.

The two main divisions of.

FOR the purposes of the dressing of these injuries it will be convenient to divide them into burns which are (1) important by reason of their extent and position, and (2) important by reason of the depth of tissues destroyed.

To the first class belong all extensive scalds or burns, especially those occurring on the chest, abdomen, or head; to the second, burns, or more rarely, scalds, wherever they may occur, in which the whole depth of the skin has been destroyed, so that on healing, a contractile cicatrix is the result.

Large superficial burns. Primary shock.

I. *Burns or scalds important from their extent and position.*

No class of injury produces such grave depression of all the functions of life, such profound "shock," in comparison with the actual damage to the tissues, as does a large burn or scald. This depression occurs wherever the injury may be situated, and is in direct relation to its superficial extent; but it is especially marked if the chest or abdomen be burnt, and is more profound in children than in adults. It may moreover be aggravated by exposure, or diminished by protection from the air, to a very marked extent.

This primary shock is often very prolonged, and when it passes off is apt to be succeeded by a congestion of internal organs, as of the lungs, intestines, cerebral meninges, kidneys, etc.; or later still, the patient may have to go through an exhaustive process of suppuration.

Times of greatest risk to life.

The periods of greatest risk to life in these cases are, first, during the few hours immediately succeeding the injury, when it may be doubtful if the patient can rally from the primary shock; and after that, during the period of internal congestion or inflammation, which rarely extends beyond the first fortnight; during this time a low form of pneumonia, ulceration of the intestines (especially of the duodenum), peritonitis, or cerebral meningitis with serous effusion, thrombosis, or hæmorrhage into the substance of the brain, or beneath the arachnoid, may, any of them take place. It is in this stage, too, that intussusception of a portion of the small intestines is said to be liable to take place.

Treatment

The immediate dressing.

The best treatment and dressing for severe superficial burns in the first instance will generally depend on the resources which are nearest to hand, for the air must be excluded from the burn as quickly as possible, and it should be covered with some light non-conducting material. Fatal damage may be done in a few moments by exposing a badly burnt chest or abdomen to the air before anything is ready to cover it; but oil or flour, or powdered whiting, or cotton wool, are materials which are in such common use, that any one of them can be readily applied in an emergency.*

The clothes must, therefore, be cut away from the burnt surface with the utmost care, so as not to further damage the tissues beneath, and over and around the wound, flour or whiting should immediately be thickly dredged, or olive oil freely poured, and then the whole part should be wrapped in cotton wool.

Management of the state of shock.

While this is being done, and afterwards, attention must be given to the condition of shock, which will generally be present. The patient must be kept warm, and should lie with the head low. Hot water bottles, etc., may be used, and ether, or sal volatile administered. If the collapse be profound, a mustard plaster may be placed over the heart, the feet put in very hot water, or ether injected hypodermically. (See chapter on "Shock" for further details as to the treatment of extreme cases of this condition.)

The later and more deliberate dressing.

When a bad burn has once been dressed, if shock be present, the surgeon should not be in a hurry to change the extemporised dressings for applications which may be in themselves more suitable, but the patient should if possible be left alone so far as dressing is concerned, until the state of collapse has passed off. In twenty-four hours, however, it will generally be necessary to redress the burn, and now (or in the first instance, if skilled assistance and proper materials have been procured) it must be done with the greatest care. If the burn be extensive, it is almost always best to perform the first two or three dressings under an anæsthetic, not only because the burnt surface is exquisitely tender, but on account of the nervous shock of the exposure.

The fresh dressings should always be got ready before the burn is uncovered. The ones generally used for burns in their early stages are—(1) "Carron" oil,* *i.e.*, a mixture of oil and lime water in equal parts. (Linseed oil was originally employed, but olive oil is cleaner.) (2) Carbolised oil. (3) A saturated solution of common washing soda.

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* Soap suds, or treacle, may also be mentioned as useful domestic applications.

Any of these may be applied by means of soaked strips of lint; and layers of cotton wool should always be placed over the strips.

The soda solution generally gives the greatest relief to the pain, but the Carron oil is also a very bland and soothing dressing. The objection to both is that the prevalent discharges very soon become foul, and for this reason we prefer, in most cases, the carbolised oil. As a rule the 1 in 40 strength is sufficient, but, for very painful surfaces, the anæsthetic effect of 1 in 20 solution is sometimes very striking.

Whatever may be in contact with the burn should not be *pulled*, but *washed* away with a stream of lukewarm Condy or carbolic lotion from a syringe, and the surface should be cleansed in the same way. It is often wise if the burn be extensive, to cleanse and dress one part of it, before uncovering the rest, and the fresh dressings should always be put on as quickly as may be consistent with cleanliness.

Small blisters may be snipped, and the serum soaked up with blotting paper, but in large ones the skin had better be cut away with sharp scissors.

Listerian dressings for burns.

A mode of dressing which is not commonly employed, but which has much to recommend it, particularly if the discharges be offensive, is to use the carbolic spray, as in Listerian dressings, and then over the carbolised oil lint to place a covering of salicylic wool, or carbolised gauze.

Other dressings.

The following dressings are also useful in many cases:—

a. The lotion of chlorinated soda (P. B.), especially if there be fœtor.

b. A mixture of chalk, or whiting, olive oil, and vinegar, in about equal parts.

c. Whiting and water.

d. Olive oil and litharge (which form a kind of soap by chemical action).

e. A solution of about ℥j of yellow soap to a pint of water has sometimes a decided anodyne action.

Exclusion of air.

Air may be strictly excluded from the burnt surface in two ways. Firstly, by continuous immersion of the injured part in a Condy or carbolic bath, and secondly, by sealing the surface with flexible collodion. This answers admirably for small burns, but for these only.

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* So called from its employment in the Carron iron foundry works.

Granulation of burns.

Granulations spring up over the surface of a burn with great rapidity, and as soon as this occurs the sore may be considered in the light of a healthy and healing ulcer, though one, it may be, of large extent. All, therefore, that has been before written as to the management and dressings of these sores will stand for granulating burns.

Skin grafting.

Skin grafting.

This process may here be conveniently described, as it is most frequently employed for the large granulating surfaces of burns, especially where contraction is to be feared.

There can be no doubt that fragments of epidermis, or even epidermal scales from the horny layer only, when applied to, and retained upon, the surface of healthy granulations, do form little cicatricial foci, which may hasten the ultimate covering in of the sore, and diminish that drawing together of the edges which is so apt to occur in the healing. Whatever the process may essentially be, and it is very obscure, it is not a transplantation, or even a "grafting" proper, for the implanted tissue is non-vascular.

Question of its value.

It is often difficult to estimate the real gain, even of successful grafting, but upon the whole it has hardly realised the promise it held out at the time of its introduction, for the islands of cicatricial tissue are very apt to disappear after they have been formed, and the quality of the cicatrix is often indifferent.

Method of grafting.

To obtain any success in skin grafting, the granulating surface must be typically healthy. Given a good soil, it is only necessary to plant a number of pieces of detached epidermis, the smaller the better, upon it, and to fix them there without disturbance for not less than two days. The grafts should only include the horny and Malpighian layers of the epidermis, and may be snipped off with ordinary curved scissors, or with the special ones (Fig. 138), devised for that purpose.

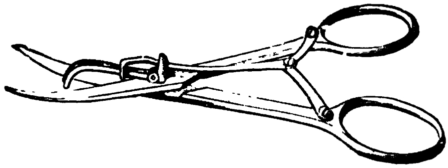

FIG. 138.—*Skin Grafting Scissors.*

The grafts should not be handled, but should be immediately placed, the dermal side downwards, upon the granulating surface, which must itself be cleansed and dried beforehand. The grafts should then be covered with small pieces of gold beater's skin, or gutta percha tissue, or isinglass plaster, or a 1 per cent. ointment of the zinco-mercuric cyanide may be spread on linen and applied under a blue wool dressing.

Transplantation of skin.

Mr. Clement Lucas (*Lancet*, October, 1884, p. 586) recommends the use of the skin, removed in circumcising children, for supplying grafts to large granulating surfaces, especially those left after extensive burns. The skin of the prepuce removed by circumcision from children with phimosis is peculiarly adapted for transplantation, on account of its suppleness, thinness, and vascularity. The time which may elapse between the removal of the skin from the prepuce and its use as grafts to a wound, may safely extend from half an hour to an hour, during which time it should be kept in warm boracic lotion. Or a piece of skin may be removed from some other part of the body, usually the inner side of the arm or thigh. If the wound be small and it is intended to cover it entirely, the procedure will be as follows: The part from which the skin is to be taken is thoroughly cleansed, and if necessary, shaved. The size and shape required should then be marked out and the piece dissected off, care being taken that no fat is left on the under surface. The graft is then transferred to the wound, and may be fixed with a few sutures.

Thiersch has introduced a modification of skin grafting in which long strips of thin skin are employed. These strips are about an inch in breadth and consist of the superficial layers only; they should be shaved off with a very sharp instrument, such as a razor.

The two last methods are also applicable to recent wounds, care being taken that all bleeding has ceased before the grafts are applied. Syphilis has been communicated by skin grafts, and the patient ought to provide his own graft.

Inasmuch as the surface of the burn or ulcer when grafted must be left undisturbed for a couple of days, it is convenient to cover it all up in salicylic wool, or boracic lint, which will hinder it becoming foul. A good number of grafts should be planted at one time, say, about one for every square inch of burnt surface, for the probability is that many will fail to take. A successful plant will be known when the part is uncovered, by the presence of a whitish pearly spot, which will increase from day to day, and will soon evidently be an island of cicatrised tissue. Other plans of grafting, such as the dusting of epithelial scrapings over the wound, have not held their ground.

Sponge grafting.

Sponge grafting.

This proceeding, introduced by Dr. Hamilton,* has also hardly justified, at present, its initial promise. Roughly speaking, the process may be said to depend on the tendency of granulations to sprout in the direction of least resistance, and to insinuate themselves into the interstices of any supporting framework. It is asserted that if this framework be itself absorbable, the sprouting granulations will cicatrise.

Sponge grafting is performed as follows: Pieces of fine Turkey sponge are soaked, first in dilute nitrohydrochloric acid to remove the silex, etc., then in liquor potassæ, and then in 1 in 20 carbolic acid solution. The pieces are then placed upon the granulating surface, and the whole dressed with Listerian precautions. The sponge adheres to the surface of the wound, and then becomes gradually filled with granulation tissue, bleeding freely when pricked. It is said that the sponge tissue proper now gradually melts away, and that the mass of organised tissue which replaces it, quickly skins over.

That a piece of sponge will fill with granulations if it be kept upon a wound is certain, but the replacement of the sponge tissue by an organised material which quickly cicatrises, has yet to be proved to take place. In any case the process is a slow one, and it has been found very difficult to keep the sponge thus filled with soft granulations from becoming foul.

II. *Burns, important through the depths of tissue destroyed.*

Of deep burns.

Of those destroying whole limbs, etc.

Those burns which destroy muscle, tendon, and bone, are either immediately fatal, as in most cases when the trunk is involved, or, if in the limbs, produce practically the same condition as that of gangrene.

As to the general management of such cases, nothing further need be said than that they require the same treatment in the first instance, as the milder kinds of burns, both for the shock, and the local injury.

Of large burns destroying the thickness of the skin.

But burns frequently are inflicted, of which the appearance at first sight is not different at all from that of the large superficial injuries we have been considering, and which indeed may be quite as large, and attended with as important a degree of shock. Nevertheless, in all the later stages of repair, this class of burns, those namely where *the whole thickness of the true skin has been destroyed*, follows a very different course from the superficial ones, and one harder to treat.

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* See *Medical Times and Gazette*, February, 1881, p. 577; and *Lancet*, February, 1881, p. 1,057.

The contraction of the scar.

Not that these burns are slower to heal than the other ones; indeed if they are left alone, they will close over more quickly, by dragging the margins together towards the centre; but it is in this contraction of the edges, and in the fact that the process of shrinking does not cease even when the sore is closed over, that the especial difficulty of these cases consists, and the dresser will assuredly find himself on the horns of a dilemma, for either he must, by fixing the parts to prevent contraction, greatly retard their healing; or if he allow the edges of the burn to come together, anyhow they will, he will quite certainly be accessory to the development of deformity, while for his consolation he has only the knowledge, that let him try his best, the contraction will almost certainly beat him in the end.

In so far as the actual dressing of the injury is concerned, the similar applications to those mentioned for more superficial burns will be appropriate.

The contraction begins very insidiously, but becomes more and more marked, and stubborn as the case goes on; as has been said, it does not cease with the covering over of the sore surface, but for months, or years, bands of contracting tissue will form in the ribbed and furrowed scar

The effect of this contraction shows worst when the face, or neck, or the flexor aspect of any large joint is involved, and most surgical text books have representations, not at all exaggerated, of the deformity which may thus happen.

Prevention or diminution of the contraction.

To combat this misfortune is very difficult, and the dresser may often wisely make up his mind to a certain amount of undeserved blame in any event. Much may, and should be done by steadily and patiently splinting, or fixing the part in some way or other, and by willingly exchanging for a quick, a very slow healing. So, too, the effect of the patient, daily, application of the solid nitrate of silver, should not be forgotten. Something may perhaps be done too by skin grafting. But probably more effectual improvement can be attained after the burn has healed by stretching the cicatrix, than during the healing. Though it has been several times pointed out, it is still often forgotten that this contracting

Stretching and other manipulation of the scars.

scar tissue is as distensile as it is contractile, if it be properly manipulated, and that by patient handling a rigid tendinous band may be converted into a supple elastic one. The results of prolonged stretching, kneading and shampooing the scars of burns are as satisfactory as those of plastic operations for the same end are disappointing.

An anæsthetic is sometimes desirable upon the early occasions of kneading and stretching, and the progress of the extension should be slow and gradual. Care must also be taken not to tear through the superficial cicatrix and thus to cause a wound. A little oil may be used to rub into the scar during the manipulation. This way of treating a contracted cicatrix is too often neglected in favour of more tempting but far less satisfactory plastic operations, and even if the latter be deemed necessary the preliminary kneading will have greatly improved the nutrition of the parts concerned.

These plastic operations themselves consist chiefly in the making of V shaped incisions and dissecting up flaps, and in the subcutaneous division of the tendinous bands.

Scalds and burns of the larynx and pharynx.

Scalds or burns of the larynx and pharynx present such especial features that they must be mentioned separately.

They are produced generally by drinking scalding liquids, and are thus far more frequent in children than in more sensible adults. (The habit of teaching children to drink out of the spout of a kettle will account for more scalds of these parts than all other causes put together.) But breathing hot air, as in a fire, may produce the same effects, and practically the action of any chemical caustic is the same in this situation as that of the thermal ones.

Scalds of the pharynx itself are not usually very serious, unless the consequent œdema of the tongue and fauces reaches a very high degree; but when the scald extends further down, so as to affect the *rima glottidis*, and the œsophagus, there is both an immediate and remote risk of complications. The remote one is that the scald of the gullet may cause a contracting cicatrix, and thus become itself a simple stricture, or that the cicatrix may be the seat of a new growth, and thus develop into a malignant one.

Calling for tracheotomy.

But it is with the immediate risk of suffocation through œdema of the larynx that we have here to do. These cases are always full of anxiety, and require very prompt treatment. If, shortly after the accident, there be a distinct difficulty of breathing, from obstruction, the safest plan will be not to wait for more urgent symptoms, but at once to perform laryngotomy, or in young children, a high tracheotomy, and then to treat the case with a warm moistened atmosphere, and in all other respects, as if it were a case of diphtheria or croup, in which the operation has been called for. But often there is a deceitful calm for some hours, and we may be tempted to think that the larynx has escaped altogether, when suddenly the most urgent dyspnœa may be developed. Whenever, therefore, inspection of the mouth and throat shows that a scalding fluid, or a corrosive liquid has passed down it, the patient must be carefully watched, made to breathe a steamy atmosphere, and the surgeon should be ready himself, and have his instruments in readiness, to open the windpipe if necessary.

SECTION V.

OF CASES REQUIRING PROLONGED OR MECHANICAL TREATMENT.

CHAPTER XXII.

Of Hip Disease.

There are certain surgical cases in which deformity is a prominent feature, which are so common, and require such patient and prolonged treatment, that every student of surgery should understand the principles of their mechanical and general management.

The most important of these are the usual forms of hip disease, of lateral and angular spinal curvature, of club foot, contracted knee, and bandy-leg.

In describing, as we propose to do, in this section, the ordinary proceedings for the treatment of these conditions, we shall confine ourselves to the manual operations and shall not discuss their pathology or treatment in other respects.

For our purpose the following different divisions of hip disease may roughly be made :—

Hip disease. Main divisions of.

	Usual lines of treatment.
(1) Acute and sub-acute hip disease.	Bed-stirrup and weight (for rest). Spica ; long splint ; Bryant's splint. Counter-irritation.
(2) Chronic hip disease, with tendency to deformity, and frequently with abscess or sinus formation.	Bed stirrup and weight (for deformity). Bryant's splint. Thomas's splint. Moulded splint.

(3) The same condition after the deformity has been treated by osteotomy.	Stirrup and weight; long splint. Bryant's splint. Thomas's splint. Moulded splint.
(4) The same condition after the diseased joint has been excised.	Ditto.

I.—ACUTE HIP DISEASE.

Acute hip disease.

In all the acute forms of hip disease, the surgeon's efforts are directed towards subduing the inflammation, so that suppuration shall not occur, and towards preventing deformity. If these ends are to be obtained, the joint must be kept at rest, and the limb kept in extension.

The main objects of treatment.

The muscles about the hip are the chief agents in keeping up irritation, and causing the deformity of flexion and abduction, and it is because muscular spasm can be better controlled by steady traction than by any other means, that the use of the stirrup and weight is so general in these cases; for although the plan was first introduced with the idea that an actual separation of the inflamed joint surfaces was thus obtained, it is now generally held that this does not take place.

The most common plan of treatment is to put the patient to bed in the supine position, with the head low; with a stirrup and weight attached to the limb, and passing over a pulley (Fig. 139); and with the foot of the bed raised, as

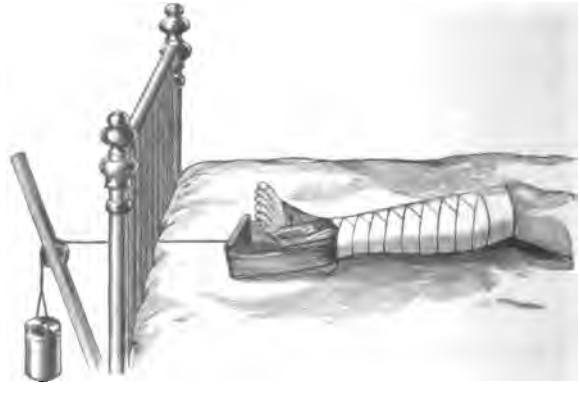

Fig. 139.—*Stirrup and Weight in position.*

described for fractures of the femur, under which heading the method of putting on the stirrup and weight will be found.

The bed. *The bed* should resemble a fracture bed in all respects, particularly in smoothness and absence of sagging.

The weight. *The amount of weight* will vary in every case, and may be anything between 3 and 12 lbs. It must be the smallest that will keep the limb at rest, but it must be sufficient for this, or it will simply act as a stimulus to the contracting muscles, and be actively harmful. It often takes some days for the spasm of the muscles to be exhausted.

Direction of pull. *The direction of the pull of the stirrup.* The pull upon the limb in these acute cases may generally be made in a straight line from the first, but sometimes it is necessary to make it first in a line with the deformity, as in the chronic cases mentioned later.

Importance of lying flat. This is essentially a children's disease, and for this reason it is often difficult at first to secure the continuous supine position with the head low. When children have once learnt that rest means ease, they will lie flat and still enough, crying only when they are moved, or when the weight is lifted from the leg. But at first it is often necessary to fasten a child down, and this can easily be done, as shown in the figure (Fig. 140), by a sort of harness of webbing by means of which the shoulders and chest are attached to the bedstead, or to a thin piece of wood running across underneath the mattress.

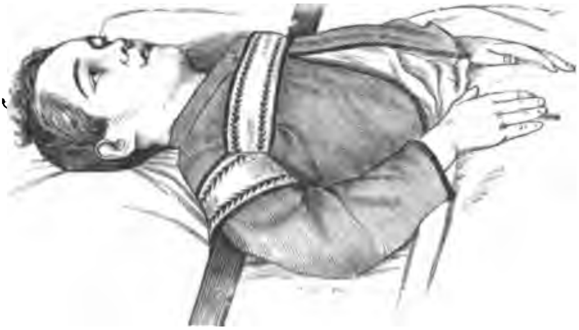

FIG. 140.—*Method of Fastening Down a Child in Bed.*

Counter-irritation. Some form of counter-irritation is generally combined with this treatment by rest. The tincture or liniment of iodine, and blisters, which may be kept open with savine ointment if desired, are the most common irritants used. Occasionally, when great pain is present, the actual cautery is applied, usually behind the great trochanter; but this treatment is more adapted to chronic than to acute joint mischief.

Other plans of treatment.

We have assumed that, at the present time, the usual treatment of a case of undoubted hip disease in its early and acute stage, is to procure rest and good position, by the use of the stirrup and weight, the raised bed foot, and the other expedients we have just considered. But it will be easily understood that there are many other ways of treating acute hip disease, and some of the more important of these we will now mention.

Stirrup *plus* the long splint.

1. By the *stirrup and weight*, combined with the *long splint*, adjusted as for fractures of the femur. This is very useful in cases where there is great pain, and where the limb becomes so ill nourished that it is unable to sustain properly without assistance the requisite pull on the stirrup.[*]

Long splint alone.

2. By the *long splint alone*. If this plan be adopted, the splint should have a foot-piece; it is not often advisable.

Moulded splint, or plaster spica.

3. By *fixation of the joint*, by a plaster of Paris or silicate spica, or by a moulded splint; this is a sufficiently effective treatment for slight inflammatory conditions of the hip joint, but it is not so satisfactory in the acute period of genuine hip disease. In the treatment of the convalescent stage, the support thus afforded may be of great value.

Thomas's splint.

4. By *Thomas's splint*. This splint will be considered in detail immediately, and from the quotations which we shall give from the inventor's own description, it will be seen that, in his opinion, it may be applied to the patient in any stage of the disease, including the earliest and most acute one, when confinement to bed is imperative. The general opinion, however, is that his form of splint is not convenient for fixing the limb in the early stages of hip disease, or so long as the patient is absolutely confined to bed.

Bryant's splint.

5. By *Bryant's Splint* (Figs. 141, 142). This is a most valuable splint for many stages and forms of hip disease, or of fractures about the hip, etc., and may here be con-

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[*] If the stirrup and weight are required for a long time, especially if there be much wasting of the limb, some of the pull should be made from above the knee; for that joint may suffer, or the upper epiphysis of the tibia may become separated from the shaft, in consequence of the constant traction,

veniently described, though it is more extensively used in chronic suppurative cases, or after excision, or osteotomy.

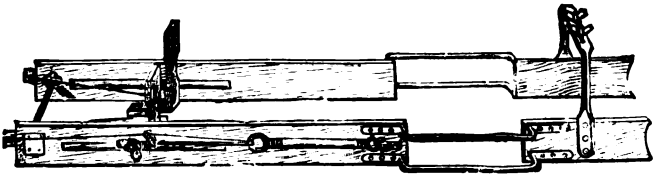

FIG. 141.—*Bryant's Splint.*

Its appearance and application are sufficiently explained in the figures. In Fig. 142, it will be seen that extension

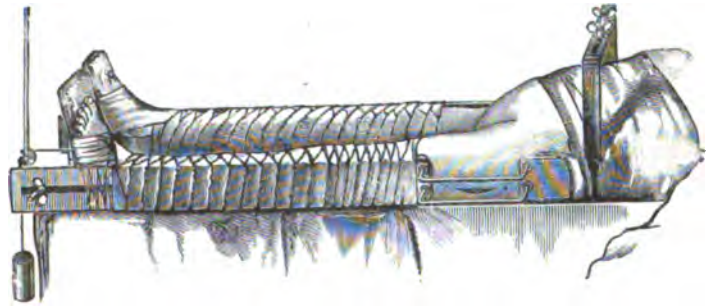

FIG. 142.—*Bryant's Splint applied.*

is made with a pulley and weight fastened to the foot piece, and this will be found better than the india-rubber springs in Fig. 141.

In the cases we are now considering, *i.e.*, cases of early hip disease, there will generally be no shortening, so that the two foot pieces should be at the same level. It is always wise to put on flannel bandages round the legs before fastening them with the ordinary roller to the splint. The interrupted part should be opposite the great trochanter, and a broad flannel roller will be found the best for fastening the trunk to the two splints between which it lies.

Its uses. The great advantage of this apparatus is that the patient can be readily lifted, or turned right over, or on to one side, the splints which run on either side being so firmly braced together above and below that the trunk and limbs are perfectly rigid, while the parallelism of the legs is well maintained.

St. Andrew's cross. 6. A splint of the form of St. Andrew's cross has been advocated, but has not come into general use, and forms of parallel long splints other than Bryant's, but on much the same principle, are employed.

Simple lying in bed with legs tied together (children only).

7. Finally, many cases of incipient or sub-acute inflammation of the hip joint in children, which, if allowed to drift on, might lead to destructive changes, may be efficiently treated without any splints, or other mechanical contrivances, by strict confinement to bed, the movement of the legs being sufficiently restrained by tying them together. Counter-irritation or other local measures, may of course be also employed.

Value of anæsthetics.

The valuable aid which anæsthetics afford in some cases of acute hip disease in their early stages must also be mentioned. It not unfrequently happens that the muscular spasm, and consequent deformity, appear to be out of all proportion to the other signs of inflammation about the joint, and the stirrup and weight fail to produce rest by extension. As soon, however, as the patient is anæsthetised, the limb comes down readily, and it is often wise to fix it then and there in good position on a Bryant's or Sieveking's splint—or to a simple long splint, while the spasm has been thus temporarily abolished.*

II.—CHRONIC OR OLD STANDING FORMS OF HIP DISEASE.

Chronic hip disease.

The treatment of these cases is always to a large extent mechanical, but will differ in accordance with the presence or absence of suppuration, or of bony anchylosis. It may be taken for granted that some degree of deformity will in all cases be present.

(1) Deformity without anchylosis or suppuration.

(1.) *Quiet, or old disease, without suppuration or bony anchylosis.*

We will take first the most common form, where the active symptoms have subsided, in great part or entirely, and where the limb has been allowed to fall into a condition of flexion and abduction, so that it can only be used for progression, by a bending and tilting of the spine and pelvis, which is generally at once aided and confirmed by the use of a high boot. In the cases we are now considering there is no bony anchylosis, and suppuration has either terminated or has been absent throughout.

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* It is not rare for the subjects of hysterical neuromimesis to simulate the contraction of the limb and other symptoms of genuine hip disease. If such a patient be put under chloroform, the symptoms due to muscular contraction will of course disappear. But they will disappear also in cases of genuine joint mischief, if this be only commencing. Cases of real joint disease may thus be put down "only hysterical" because the suspected articulation, usually exquisitely tender, has been found to move with freedom when the patient was anæsthetised.

In these cases the general plan of treatment is to keep the patient lying down, and to try, by means of the stirrup and weight, to pull the limb gradually straight, the weight employed being generally greater than in acute cases. The foot of the bed should also be more raised.*

Lordosis. Unless the case be a very simple one, it will be found that the limb apparently lies straight enough directly the weight is put on; but if the hand be now placed below the lumbar spines it will be seen that they form an arch to an **Its cause** extent corresponding to the deformity. The appearance of improvement is therefore quite deceptive, and the weight is doing little or no good. It must always be kept in mind that, for the apparatus to be of any avail in reducing deformity, no lordosis must be allowed, that is, the back must be in contact with the bed all along. The only way to secure this is to make the "pull" of the stirrup almost in the direction of the flexion of the femur, and of its adduction as well, unless this latter be slight. **How remedied.** This may most readily be done by attaching the pulley-block to a standard placed at the end of the bed, so that it may be raised or lowered (Fig. 143). The standard also may be shifted laterally.

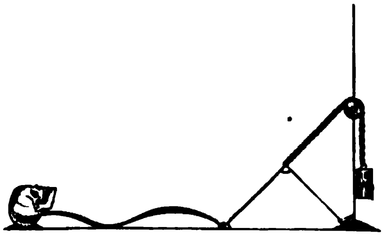

FIG. 143.—*Diagram of Pulley and Weight making traction in direction of deformity.*

It is best during the first week of treatment to make no attempt at reduction of the deformity, but simply to get the parts at rest, and to abolish muscular spasm, by making traction in the direction which the femur assumes when the spine is flat on the bed. Then inch by inch, and very gradually, the limb may be abducted and extended. When the extension has done its work, if the parts are quiet and free from pain, a spica of plaster of Paris, silicate, etc., or a felt or leather moulded splint (Fig. 118) may be put on, and the patient may begin to get about on crutches, or Thomas's treatment may be begun.

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* This treatment may be sometimes combined with that of forcible straightening under an anæsthetic, to be mentioned directly.

Thomas's splint.

Thomas's splint. The mechanical principles on which many cases of hip disease may be successfully treated with little or no confinement to bed, are fully explained and advocated by Mr. H. O. Thomas, in his book on this subject,* and although many surgeons may be little disposed to agree with his doctrines in their entirety, there can be no doubt that the extent to which his splint has come into general use, marks a distinct advance in the treatment of this disease.

Its objects.

The objects of Mr. Thomas's splint are, first, to secure rest, and to avoid friction, by means of posterior fixation of the hip joint, together with the trunk, thigh, and leg; and secondly, to allow the weight of the limb gradually to remedy the deformity, in the place of a more active form of extension.

Inasmuch as we find ourselves unable to accept Mr. Thomas's views, as to the applicability of his treatment to all stages of the disease, while at the same time we consider that in the later periods it is extremely valuable, we have thought it best to give, slightly condensed, his own account of the fitting on of his splint. It will be seen that if success is to be obtained much personal care and attention must be given by the surgeon.

MR. THOMAS'S ACCOUNT OF HIS SPLINT.†

We will suppose the patient, *æt. ten*, with right hip joint disease. The surgeon requests him to stand on the left limb, and proceeds to measure him for the instrument. A block, or several if necessary, is placed under the sole of his right foot, until the sound limb is raised sufficiently to allow the spine to resume its natural form.

Now he takes a long, flat piece of malleable iron, one inch by a quarter for an adult, and three-quarters of an inch by three-sixteenths for children, and long enough to extend from the lower angle of the shoulder-blade in a perpendicular line downwards over the lumbar region, across the pelvis slightly external, but close to, the posterior superior spinous process of the ilium, and to the prominence of the buttock, along the course of the sciatic nerve, to a point slightly external to the centre of the extremity of the calf of the leg. The iron must be modelled to this track to avoid excoriations.

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* "Diseases of hip, knee, and ankle joints." Liverpool, 1876.

† *Loc. Cit.* pp. 28—42.

The lumbar portion of the upright must be invariably almost a plane surface, and rotated on its axis in the direction of the arrows (Figs. 144, 145) more or less in proportion to the plumpness of the patient. This iron forms the upright portion. It is very necessary that it should come below the knee, to enable the surgeon to fix this joint.

Then measure round the chest, a little below the axilla, deducting, in the case of an adult, four inches from the chest circumference. This latter will be the measure for the upper cross piece, which is made from a piece of hoop iron, one and a half inches, by one eighth of an inch. The hoop is firmly joined to the top of the upright with a rivet at one third of its length from the end next to the diseased side. (Fig. 144). It is important to give the upper crescent this oval shape, to assist in arresting the machine from rotating from its position behind the body, and thus producing inversion of the limb.

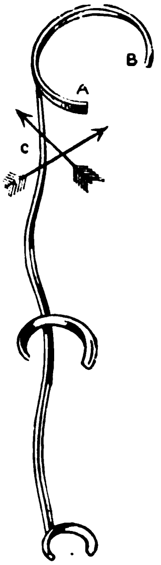

FIG. 144.—*Single Thomas's Splint.*

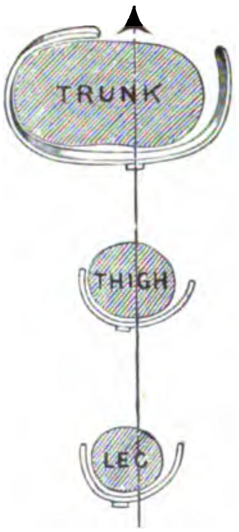

FIG. 145.—*Section of Trunk and Limbs at level of the half circles of the Splint.*

Another strip of hoop metal, three quarters of an inch by one eighth of an inch, and in length two thirds of the circumference of the thigh, is fastened to the upright, at a position from one to two inches below the fold of the buttock; then another piece of metal of like strength, equal to half the circumference of the leg at the calf, is firmly riveted to the lower extremity of the upright.

The short portion of the top half circle is next to the diseased side, with a space intervening, while the long portion must be closely fitted to the sound side. If the machine should tend to rotate from the disused side, then daily contract the long wing of the crescents, and expand the short ones.

In applying the instrument with two uprights (Fig. 146), care should be taken to measure the distance between the tip of right and left posterior spinous processes, and then to set the uprights parallel and apart one inch more than such measurement, or it cannot be tolerated by the patient. The two uprights should be connected by a cross-bar when practicable, which is not possible when the double instrument is used for reduction of deformities; when used it will be found useful for the attendant to grasp in nursing.

The instrument is now ready to be padded and covered. The former is conveniently done with boiler felt, the latter with basil leather.

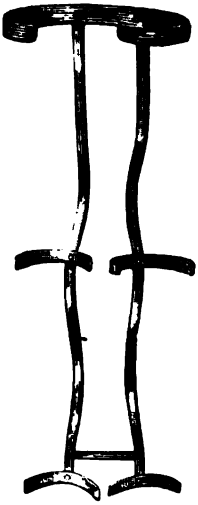

FIG. 146.—*Double Thomas's Splint.*

It will often occur that some slight alteration will be demanded, at some period during the progress of the case, and if it is one attended with much deformity, the surgeon will, for a few weeks, occasionally have to alter the curves of the appliance. This modification he should be prepared to perform himself, with wrenches.

The patient being placed in the machine, the upper circle round the chest is closed with a strap and buckle, and the limb is bound with flannel from the calf upwards beyond the small crescent.

Should the instrument rotate towards the diseased side, and so become a side splint, the surgeon should contract the longest wing of the upper crescent, and expand the shorter one; or if the instrument does not rotate, yet the stem is not over the prominence of the buttock and well behind the thigh, then the upright requires more twisting.

It is very desirable that the patient should be confined to bed for the period at the commencement of the treatment. This preliminary reclination I have never noticed to injure the general health, but invariably improves the patient's condition, and shortens the acute stage.

The surgeon being satisfied that suppuration has been avoided during the first stage of the mechanical treatment, permits the patient to proceed on to the second stage. He is then allowed to go about with the assistance of crutches, the frame is continued, and an iron patten at least four inches in depth is placed under the shoe of the sound limb (Fig. 147). These must be worn day and night until the limb is well atrophied around the great trochanter, the outline of which should be more discernible than that of the sound side.

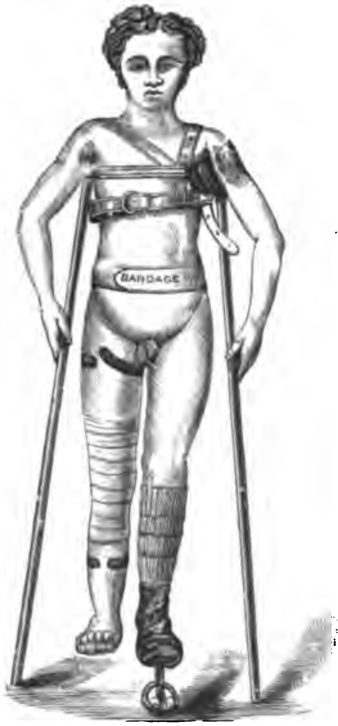

Fig. 147.—*Thomas's Splint applied—front view.*

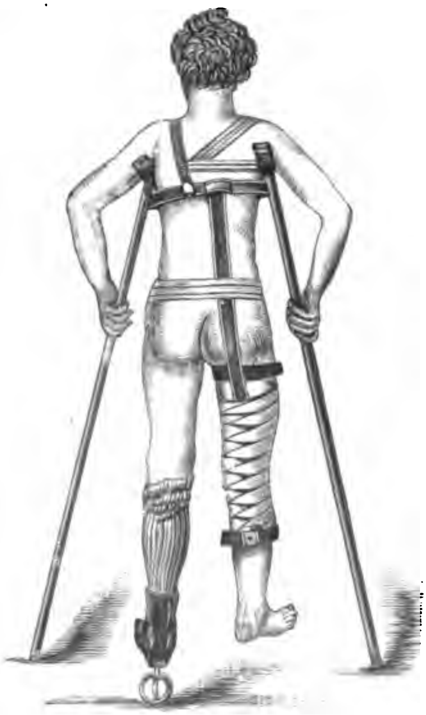

Fig. 148.—*Thomas's Splint applied – back view.* (*Reduced from Mr. Thomas's book.*)

Now we come to the third stage. The patient takes off the framework in bed and replaces it during the day, still using the crutch and patten for a certain period.

We now arrive at the fourth stage. The patient totally discards the frame, and uses the crutch and patten only. These he sets aside after the surgeon is well satisfied with regard to the permanence of the cure. If the case does not progress to the satisfaction of the surgeon, some of these stages must necessarily be prolonged.

The weight of the lower extremity is equal to reducing any angular deformity of the hip or knee joint, not resulting from true anchylosis, and is capable also in some degree of diminishing any shortening, should absorption of the head of the bone occur, provided a suitable mechanical arrangement be applied, and continued during a sufficient period.

The splint ought to be applied at once, whatever be the stage of the disease. Forcible flexion, extension, tenotomy, or chloroform, are to be avoided as unnecessary. In the presence of my method these operations are undesirable, though they were essential at one time. Even should the deformity be an extreme one, no violence must be attempted; the limb should be gently persuaded to come back from the erring position, and as it assents, the wrenches should be used to alter the hip instrument towards the normal line.

From this account it will be seen that Mr. Thomas advocates his splint and plan of treatment in all stages of the disease. For the reasons we have already stated, we believe that its great value will be found in the treatment of subacute and subsiding cases, with only a moderate amount of deformity. The advantages gained by not having to confine the patient to bed are here very great, and most certainly, if the splint fit properly, and be well looked after, the weight of the limb does, in practice, act as a most efficient agent in the reduction of the deformity.

We have found that a piece of leaden gas tubing, flattened out, acts better for the modelling rod, than the malleable iron Mr. Thomas advises.

The flexibility of the lumbar spine is always very great, and is especially marked in children; the patten should, therefore, be in them not only relatively, but absolutely as high, or higher, than is necessary for adult patients.

Forcible straightening.

Forcible straightening of the limb, the patient being under an anæsthetic, with tenotomy, where necessary, is sometimes a very successful treatment. It is only applicable to those cases in which the inflammatory mischief has passed away, leaving contraction of the muscles and adhesions about the joint.

It may not be possible to bring the limb quite down at one operation, but the improvement must be maintained to its full extent by putting on a Bryant's splint, or a common long splint, before the effect of the anæsthetic has passed. Later on a moulded felt splint, or a plaster spica may be applied. If any tendons require to be divided, they will probably be those of the adductor longus or the tensor fasciæ femoris. The operation is in all cases quite simple.

(2) Hip disease with abscess formation.

(2.) *Cases which have run on to suppuration, in which excision is not considered advisable.*

These cases differ very widely among themselves. In some, the disease runs a favourable course to consolidation, its duration not being much affected by the abscess formation; in others the formation of pus is the first chapter in a history of hectic fever, and of steady exhaustion.

In the chief practical points, the manipulative management of this class does not generally differ from that of the one which has just been considered, and the choice of the line on which the treatment is to be carried out must be made on general surgical principles.

Danger of bed-sores.

The risk of bed sores must be kept in mind if confinement to bed be decided upon. These are apt to occur in severe cases during the treatment by the stirrup and weight, unless great care be taken. If there be any tendency to their formation, it will hardly be possible to carry out this plan of treatment efficiently, but the patient may be put into a Bryant's splint in the prone position (see treatment after excision), or in the ordinary fashion, or may lie on a softer bed, or on a water cushion, in a Thomas's splint very carefully fitted.

Tendency to flexion of limbs

In extreme cases of emaciation the temptation is great to allow the legs to be drawn up, so that the body may lie over to one side more easily, but the limbs must never be allowed to assume this position if it can in any way be prevented.

Treatment of the abscess.

With regard to the abscess itself, when it becomes necessary to evacuate the pus, aspiration should in most cases first be employed, and may be repeated, for it sometimes happens that after the abscess cavity has filled once or twice, suppuration ceases. If it does not, sooner or later the cavity must be thoroughly drained.

A sufficient opening at the most dependent part, and counter openings being made, a piece of drainage tube, or a wisp of horsehair may be passed right through, or two pieces of tube may be used. It is then easy to wash out the cavity with Condy, or carbolic, or iodine, or with any lotion that may be ordered. (See the treatment of abscesses, in the section on Minor Surgery.)

The opening and subsequent dressing is commonly performed with strict antiseptic precautions. The absorbent salicylic wool will be found very useful here if there be much discharge, and it is often wise to put a certain amount of elastic pressure over the abscess walls, as with a Martin's bandage arranged in a figure of 8, particularly when the patient is beginning to get about.

When osteotomy has been performed.

(3.) *Cases in which division of the neck of the femur has been performed.*

Supposing the operation of osteotomy of the femoral neck to have been successfully performed, the deformity will not be cured without the most careful after treatment. An interrupted long splint, or a Bryant's (which is better), is generally used at first, and later, a Thomas's, or a moulded one. The stirrup and weight are sometimes, but more rarely, used, but the after management of these operation cases will vary with the individual practice of the operating surgeon.

When the joint has been excised.

(4.) *Cases in which excision of the joint has been performed.*

The same remarks apply here as to the preceding class, save that osteotomies are performed as a rule, on well-nourished, healthy subjects, while cases calling for excision are often much exhausted by irritative fever and suppuration.

Bryant's splint.

Of all the splints, we believe the best to be certainly Bryant's (see Figs. 141, 142). It has this advantage over others that, if desired, the patient can be put into it in the prone position; this is often very useful for cleanliness, especially soon after the excision, in children, or if there be a tendency to bed sores.

Regulation of the traction.

It is easy to exert too much traction on the limb after excision, and care must be taken to maintain the proper amount of shortening, neither allowing the shaft to slip up and irritate the pelvis, nor to be pulled down so that the interval at the site of the excision is too wide to be filled up in the course of consolidation.

Other splints, etc.

If a plain long splint be used, it must have a sufficient interruption and a foot piece. This splint may be combined with a stirrup and weight, as in fractures of the femur (*q.v.*), or the stirrup may be used alone, in which case there is the risk of over extension which has just been mentioned.

In the later stages of consolidation, a Thomas's splint is very useful, and later still, a spica of plaster of Paris, or a moulded splint.

CHAPTER XXIII.

OF THE "JACKET" TREATMENT IN SPINAL DISEASE.

Of the Application of Jackets in Spinal Cases.

General considerations.

Since the introduction of the jacket treatment of spinal disease, numbers of these cases have been rescued from the hands of the instrument makers, or from a confinement, both irksome and demoralising, to the bed or couch.

Nowadays, every surgeon is expected to know how to put on a plaster or felt jacket, and every dresser should acquire the knowledge of a mode of treatment which has produced such important changes of practice.

This is not the place to discuss the pathology and treatment of spinal cases, but at the same time it should be understood that the early stages of the disease are generally, if not always, best treated by strict recumbency, and that not all cases of true spinal disease are suitable for the jacket at any stage.

A jacket, placed on a patient who does not require one, is actively harmful, hampering respiration and growth, and depriving muscles and joints of their power of movement and development.*

Unfit cases.

Especially among the unfit cases may be mentioned those rickety spines so common in quite young children, and cases of simple lateral curvature, due to laxity of ligamentous structures, where the deformity has not produced noteworthy visceral displacement and is not associated with other diseases, such as paralysis.

But when all the unfit cases are excluded, there will still remain such a very large class of patients for whom a jacket is by far the readiest, cheapest, and most appropriate treatment, that its application should not be allowed to become a speciality, but should be understood by all general surgeons.

The two kinds of jackets which we shall particularly describe are made respectively of plaster of Paris and poroplastic felt, but the principle may be carried out in other materials, such as leather, gutta-percha, or paraffin.

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* See the Author's paper on this subject in the "Proceedings of The International Medical Congress," 1882, Section, Diseases of Children.

The end desired is to immobilize the spine about the seat of the disease, and to fix the whole spine in the best position possible, that is, with as little curvature and rotation of the vertebral sections as the extent and stage of the disease will allow.*

The necessary conditions.

To do this by means of any splint or case, moulded to the body, it is obvious that it must be fitted (1) while the trunk is as much extended as it may, or rather as it ought, to be; (2) with the thorax in the position of inspiration; (3) with

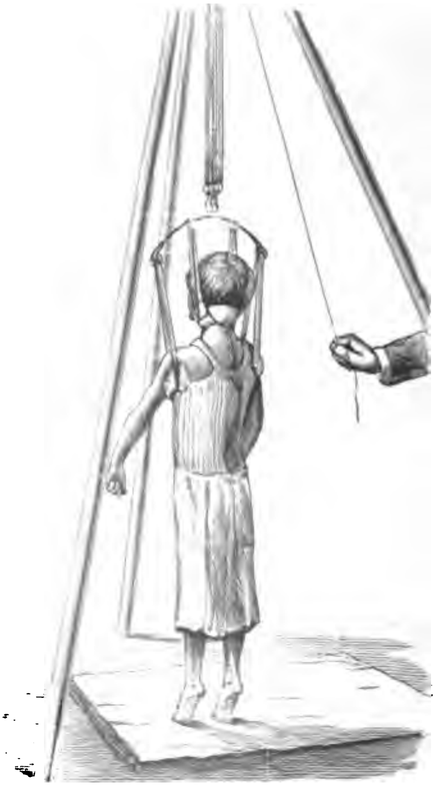

FIG. 149.—*Suspension (partial) by Tripod and Pulleys.*

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[*] If the disease be high up, as in the cervical spine, the vertebræ can hardly themselves be fixed, but the manner of supporting the head will be described directly (see "Jury Masts").

all bony prominences protected; (4) with a good hold on the pelvis to serve as the basis of support.

It must also be as light as is compatible with strength, and be loose enough over the abdomen to allow of moderate distension by food or flatus.

Extension of the trunk.

The extension of the trunk may be attained by Dr. Sayre's method of suspension, or, in the case of children, by simply holding them up with the hands in the armpits, or by the inclined plane; this latter, however, cannot be used for the ordinary plaster case.

By suspension.

Of these three methods, the suspension from the tripod requires the most care. As shown in the figure (Fig. 149), the patient can be suspended with the feet just *off* or just *on* the ground—in England the general practice, with which we thoroughly agree, is not to swing the patient clear of the ground—by means of straps and padded slings, which pass round the head and beneath the axillæ, and are attached to a crossbar, itself connected with a cord passing over a system of multiplying pulleys. By means of this cord, partial or complete suspension may be attained by the patient himself, or by an assistant, with a very moderate amount of force.

In severe cases, or if there be any loss of power in the legs, the patient may conveniently sit under the crossbar, inside the tripod, and have the slings adjusted.

Objections to this method.

The objections to the suspension apparatus are, that in children it is alarming and fatiguing, and even for adults it is generally a trying ordeal. For most cases it is no doubt safe enough, but delicate patients must be watched lest faintness comes on, and if the consolidation of the vertebræ be only in its early stages it is impossible to be too careful not to inflict damage by forcible extension. Unfortunately, it is difficult to estimate the force which is being employed, owing to the multiplying pulleys.

Speaking generally, however, it may be said that for adults, if the ordinary plaster case is to be applied, gentle suspension from the tripod, in the standing or sitting position, will be best; but that for young children, suspension by an assistant with the hands in the armpits is much to be preferred.

The inclined plane.

The simple inclined plane, with the arms thrown over the head and grasping a bar, is even a better and safer way of producing extension in the position of inspiration. This position cannot be maintained while a bandage is being rolled on the trunk, so that it will not do for an ordinary plaster case; but for the poroplastic jacket, or for a modification of the plaster one to be presently described, it has much to recommend it.

Inspiratory position.

The inspiratory position of the chest-walls is secured by the raising of the hands, if the inclined plane be used, and this is the case also with the tripod, if the patient be self-suspended; if not, the hands may be raised to grasp the legs of the support, but the management of this is often a difficulty. In holding up children by the hands in the axillæ, it is easy to maintain the desired position of the arms and chest-walls.

The protection of prominences.

The protection of prominences is most important. Not only the angle at the curvature of the spine, if one be present, but any other projection which seems in the least likely to be rubbed, must be protected by pads placed on either side, or around, but not over it. The pads are best made of tow, covered with old table linen, and are placed in position next to the skin. Careful moulding of the case to all irregularities, by pressing and squeezing it into shape before it sets, will also prevent chafing.

The hold on the pelvis.

The hold on the pelvis is very important, and its neglect is the most common cause of failure of the treatment. If the case merely encloses the trunk as in a barrel, there is no relief afforded in the way of support of the weight of the head and upper extremities, nor is the rotation of the spine at all prevented. The requisite grip is easily secured by taking care to bring the bandage, or the felt, at least 1½ inches below the iliac crest, and to mould the case to the prominence of that bone.

We will pass now from the consideration of the general principles of the jacket treatment, to a description of the actual application of the common plaster jacket, of its modifications, and of the poro-plastic jacket.

Application of plaster jacket in ordinary manner.

We will take first the case of an application of the jacket in the ordinary manner. A time should be chosen not less than two hours after a meal, if possible upon a dry day, and there should be a fire in the room in which the operation is about to be performed. A firm horse hair mattress should be laid on the floor near the fire, ready to place the patient upon as soon as the jacket is adapted.

The jersey.

The patient is then stripped, and the cinglet or jersey which is to go under the jacket, and which should be of a kind specially made for the purpose, is slipped on, and the tags for the shoulders tied, or fastened with safety pins (on no account must an ordinary pin be used anywhere in these cases). The pads must then be adjusted to protect the angular curve, when necessary, as it almost always is. If the abdomen be unusually retracted, it is wise to place a temporary pad to bring up the circumference of the jacket there, to its normal size. The permanent pads at the back or elsewhere should be fastened to the cinglet with a stitch or two, after they have been carefully adjusted. The bottom of this garment is then fastened, back and front together, between the thighs with a safety pin.

The pads.

The suspension.

All is ready now for suspension. In the case of a child, as we have said, this is best performed by an assistant placing his hands in the axillæ, so as to grasp the arms at their highest point. The child can thus easily be held with the shoulders well thrown back and with the toes just touching the ground. But if suspension by straps and pulleys is to be employed, the patient must have the head and shoulder slings of the tripod adjusted so as to give an equal pull upon every part, as seen in figure No 149. The straps of all the slings, and of the chin and occiput supports, can be altered to suit different patients, and too much care cannot be taken to get the support exactly right before applying the bandage. As a general rule, the patient stands for the suspension ; but if there be great weakness, or any paralysis, or simply if it be found more comfortable, a seat without a back (a rotary music-stool does best) may be placed beneath the tripod.

When the slings have once been adjusted, the actual raising should not be made until everything is ready for the application of the bandage, and in our opinion it is never advisable to swing the patient quite clear of the ground or stool.

The general manipulation of rolling on a plaster of Paris bandage has already been described, and this particular form does not differ in any essential point.

Application of the bandages.

Six or eight freshly-rubbed muslin bandages will be required, and both they and a small quantity of loose plaster should be put into an oven for about an hour before they are wanted. In moistening the bandages, a large basin of warm water should be used ; as soon as one is ready, it is taken out and another is put in the water, while the surgeon rapidly rolls the first on to the trunk of the patient, allowing the bandage to take pretty much its own course, but endeavouring to work generally in figures of 8, the upper loop encircling the chest and the lower one grasping the pelvis. The bandage must on no account be drawn upon, but merely rolled on. When the first is finished the second is taken out of the water and a third one put in, and so on. As a rule, for a child of eight years of age, four bandages will be enough to make a jacket three layers thick everywhere, and four layers in the parts that most require strength. For an adult, six will generally be necessary.

While the bandages are being rolled on, an assistant should rub in additional loose plaster with the hand, moistening it as is required; and when the bandages are all put on, the whole jacket must be worked over with moistened plaster, well rubbed in, until the surface has a uniform greasy feeling. The prominences of the pelvic crest, the spine, etc., must now be moulded before the plaster sets.

All this must be done very quickly, for the position is a fatiguing one. In most cases it is wise to have one assistant whose whole care it is to watch the patient, and to look after the suspension. If in the process of applying the jacket, any symptoms of embarrassment, either to the breathing or circulation appear, the patient must be promptly let down.

Removal from the suspension

When the application is finished, some patients, if there be no great discomfort, may be left partly suspended for about ten minutes while the jacket begins to set, but as a rule it is advisable to remove them from the apparatus as soon as possible, and lay them flat on the mattress, placed ready on the floor near a fire. The removal must be made with great care, so as to avoid any cracking of the case. Hot water

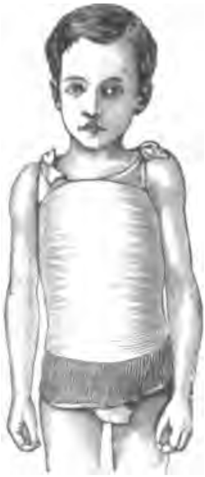

FIG. 150.—*Plaster of Paris Jacket applied.*

bottles, or hot bricks, laid near the case will hasten its drying, especially in damp weather.

As a rule the patient had better remain still for three or four hours while the case is setting. It will then probably require a little trimming and cutting away in the armpits, etc., which can conveniently be done with a sharp knife.

The safety-pin in the perineum, and the stomach pad, when present, can be removed as soon as the patient is laid down.

Figure 150 is drawn from a case of angular curvature of ordinary severity, in which a plaster case had been applied.

Modifications of the above method.

Modifications

Metal strips.

(1.) It is sometimes advisable to especially strengthen the back, or one side of the case, when there is a great tendency to yield, or when the patient is unusually heavy. If this be done by increasing the amount of bandage, the case is apt to be made too heavy, but a very good way is to work into the plaster, strips of tinned iron about half an inch wide, with holes roughly punched in them to make the plaster hold better. These are laid along the jacket as it is being made, and are incorporated within its folds.

Changing jacket, etc.

(2.) One great drawback of this jacket treatment is the impossibility of getting at the skin to wash it, or of cleansing the cinglet, and, among the poor, there is great difficulty in avoiding the presence of vermin. If only one cinglet be used, it cannot be changed without making a new jacket.

There are two ways in which this difficulty may be partially overcome. The first, recommended by Mr. Keetley, consists in laying two clean handkerchiefs or napkins, back and front, between the cinglet and the skin (and of course inside the pads) before the jacket is applied. When these have to be changed, this is easily done by pinning a clean napkin to the lower edge of the soiled one, which should project a little below the plaster jacket; then, by pulling the latter out at its upper end, the new follows the old one and lies in its place.

The other way is on the same principle, and is Mr. Oxley's device. Two cinglets, instead of one, are worn throughout the treatment (the pads being fastened to the outer one only). The outer one adheres to the plaster, and forms part of the case, but the inner one can be removed by pulling it off, over the head and shoulders, after having tacked a clean one to its lower edge all round.

Method of application while lying down.

(3.) A more important modification is due to Dr. Walker, of Peterborough,* by means of which the swing may be dispensed with, and a plaster jacket be put on while the patient lies flat, or better still, extended on an inclined plane, with the hands raised backwards above the head, and grasping a bar.

To carry out this plan it is necessary to retard the setting of the plaster. This is effected by soaking the muslin bandages into the interstices of which the plaster has been rubbed in the ordinary way, in a mixture of mucilage and water (about 1 oz. to a pint of water). When the roller bandages have been thoroughly moistened, they are cut into lengths sufficient to go round the body of the patient, and to overlap some inches in front. The several lengths are then arranged on the inclined plane so as to form a series of overlapping strips, in sufficient number to secure a three or fourfold thickness everywhere.

The cinglet having been put on, and the pads adjusted, the patient is placed in the extended position, over the strips of bandage, which are then taken up, one by one, and their ends crossed over the front of the chest and abdomen, like one loop and a bit of a figure of 8. If they have been properly placed, it will be found that in this manner a well-fitting jacket of a somewhat hour-glass shape will be made, expanding above for the upper part of the thorax, and below to take a hold of the pelvis.

The patient should be allowed to lie still until the case sets, which it will do in three or four hours.†

The time occupied in the actual application of this jacket will generally be a good deal less than in the case of the ordinary one, but even if this were not so, the saving of fatigue, and the other advantages incident on the doing away of the necessity for suspension, are sufficient to make this plan a very valuable one in many cases.

On the other hand, it would be quite easy to make the jacket by means of short over-lapping strips instead of the long roller bandage, while the patient was suspended in the tripod, if it were so desired, but this does not seem to have come into practice.

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* See *British Medical Journal*, 1879, Vol. I., p. 305. Also a Clinical Lecture, by Mr. Furneaux Jordan, *Lancet*, 1880, Vol. I., p. 905.

† Mr. Furneaux Jordan (*loc. cit.*) uses instead of a number of strips, three or four wide "compound" ones, each of six or eight thicknesses of muslin and plaster, or of three or four layers of honeycomb toweling and plaster. In either case the number of layers seems excessive, if there be a proper amount of plaster incorporated.

Mr. Davy's plan. (4.) Mr. Davy has adopted for some time past, and has fully described a plan of "hammock extension," face downwards, for the purpose of putting on a plaster jacket, for a description of which the reader is referred to his paper.*

Suggestions have often been made of slitting up the jacket in front, and sometimes of making a hinge behind, so that it may be removable, but in practice this has not been found to be successful.

Trap doors. When the prominence of the angular curvature is the seat of an ulcer, it is not generally wise to put on a jacket at all, but it is sometimes advisable to cut trap doors for this condition, or opposite the opening of discharging sinuses or abscesses.

Poroplastic jackets.

Poroplastic jackets. The moulding of *resinous felt* into a spinal jacket does not differ in its main principles from the moulding of that material for other splints, but the large amount of felt employed, together with the great rapidity with which it sets, makes a certain amount of practice necessary in order to be able to fit a case of spinal curvature properly.

Their advantages. A well-fitted poroplastic jacket is often an admirable method of treatment. It is not much more than half the weight of a plaster one, is porous, so that the action of the skin is but little interfered with, and it can be removed altogether, or widely loosened, at frequent intervals, for the purposes of cleanliness, although it will not long stand being taken off every night, as is sometimes advised.

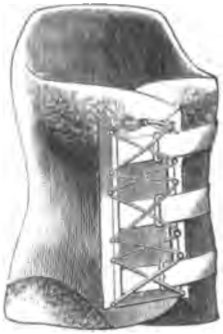

FIG. 151.—*Poroplastic Felt Jacket.*

These jackets are sold roughly blocked out (Fig. 151) in a sufficient number of sizes, and of three qualities, of which the two more expensive are about equally good, though the dearer one is rather the lighter of the two. The third and coarsest quality is not here recommended.

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* *British Medical Journal*, 1880, Vol. I., p. 959.

The jackets are fitted with the necessary straps and buckles and eyelet holes, and lately an additional improvement has been to leave unstiffened the felt corresponding to the front iliac spines, and (in women) to the breasts, as shown in the figure. Other parts may also be left unstiffened as required, as over tender prominent ribs, or spinous processes.

Fitting by means of a cast. A jacket of about the right size having been chosen, it must be accurately fitted to the body of the patient, while the position of extension is maintained.

One way of doing this is to take a plaster cast of the trunk, and block the jacket upon that instead of upon the body. This is a plan very generally followed by instrument makers, and has this advantage, that any number of jackets can be moulded in the future without further trouble to the patient. But the first cast is difficult to make, except by a professional modeller, and generally speaking, the position of extension is not well maintained.* A cast, however, would be absolutely necessary if leather were used instead of felt.

By the tripod. But the general practice is either to suspend the patient from the tripod, or to procure the extension, and the inspiratory position, by means of an inclined plane. As we have said before, we consider the latter is, in ordinary cases, to be preferred.

By the inclined plane. In either case, the fitting of the cinglet and pads is just the same as if the plaster jacket were about to be made, and if the tripod be used, the head and shoulders are adjusted exactly as has been before described. If the plan of the inclined plane be chosen, the patient lies down on it, and, raising the arms above the head, catches hold of some bar or support. The best inclined plane is the simplest, namely, a board about two feet wide, and with an inclination of about two feet in six. There must be no foot-piece, nor any pillow for the head.

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* The Author has recently made a cast of the inside of an old jacket serve as the model on which a new one could be blocked, and found that it answered the purpose very well; all that was required was to pour plaster of the consistency of cream into the jacket standing on a board, as into a bucket, the straps being buckled to close it in front. If a layer of paper be pasted inside there will be no adherence of the cast to the felt mould, or, better still, the mould may be oiled.

Softening the jacket.

The same method of softening the jacket can be employed in either case. This can be done very well in a good-sized oven at the ordinary cooking heat, in which the jacket should be suspended from some support, such as a surgical cradle; it must hang free, and must not touch the sides anywhere or it will burn; it must also be well moistened, and a pan of water should be placed on the floor of the oven.

In the kitchen oven.

In a special steam chamber.

But upon this plan it will be necessary to bring the patient to the oven, *i.e.*, in most cases, into the kitchen, and it is naturally more convenient to bring the oven to the patient. This may be done by using a specially contrived steam chamber, sold or let out by instrument makers, and which consists of an iron cylinder with a double bottom, into which an oil stove-lamp, a spirit-lamp, or a gas-jet, is put. A pan of water stands within the cylinder, which has a tight-fitting lid.

Application of the jacket.

The lamp quickly generates the steam, and there should be heat enough to thoroughly soften the jacket in three or four minutes. It is then ready for application and must be *at once* and *as quickly as possible* put on. According to the description of Mr. Swain,* the patient being suspended from the tripod, an assistant (who is advised to have gloves on) quickly draws, first the waist-strap and buckle together, then the pelvic ones, and lastly those about the breast, the responsible surgeon the while moulding and kneading the felt to the prominences of spine and other parts.

This is a good plan to follow, but a better, is to have ready cut, six or eight lengths of broad, stout bandage stuff, then, whether the patient be suspended or be lying on the inclined plane, the jacket can be quickly slipped on and the sides brought round into position, care being taken that the softened parts of the felt correspond to the hips and breasts, and that the buckles come opposite the straps. The lengths of bandage are then quickly passed round and knotted in front by the assistant, while the surgeon brings the sides accurately forward, and moulds them as he does so. The waist bandage is tied first, then those for the hips; the breast ones next, and then intermediate ones as may be required. In this way all fumbling with hot buckles and straps is avoided, the jacket is easily put on before it can set, and a closer, more accurate fit is attained.

The jacket sets too firmly in a minute or two for any further moulding to be done, but it is not really strong for about half an hour, so the patient must lie still for that time, if on the plane, or may remain semi-suspended if this can be borne, or as in the case of the plaster, may be carefully released from the tripod and laid flat on a mattress, this time *not* close to a fire.

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* *Lancet*, 26th June, 1880.

When the felt has set, the bandages may be cast off, and the straps and buckles closed. These will very likely require some adjustment, and for this reason it is often wiser to mould the jacket *before* the straps and buckles are sewn on.

Trimming, etc.

The jacket itself will almost certainly have to be cut away somewhere, or slightly altered, and this may be done in one of two ways, as may seem best; namely, with a hot iron, which will re-soften parts that do not quite fit, or by dissolving out of the felt, the resin, with spirits of wine sufficiently to make it much more pliable. This is often a very good plan for such parts as the arm-pits.

Re-application of the jacket.

If the jacket be a failure, or if, as ought to happen in the progress of a case, it seems as if a further improvement were possible, the case must be slipped off and re-softened in the steam chamber, unless it be badly cracked, or be worn out.

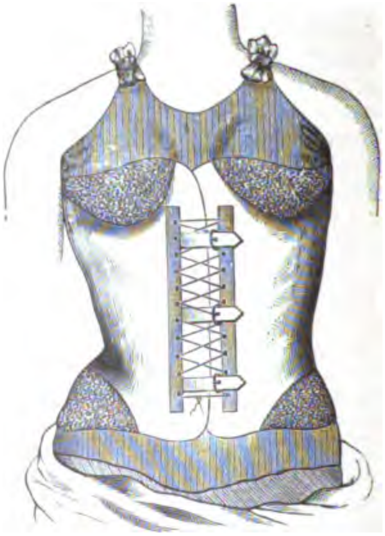

FIG. 152.—*Poroplastic Jacket applied.*

In Fig. 152 is shown a felt jacket, moulded to an adult case of bad lateral curvature. In this case a similar jacket had been worn for several years.

Jury mast.

Methods of support in Cervical caries—Jury masts.

When the seat of the spinal disease is in the cervical region, it is obvious that no jacket can, of itself, fix the vertebræ. In acute cases it is generally necessary to make the patient lie absolutely flat, with the head fixed with pillows or sand bags.

But there are many stages in the disease, in which it is both safe and advisable to allow the patient to get about, provided that in some way or another the weight of the head and neck can be taken off the diseased vertebræ and thrown elsewhere. This may be done by various patterns of steel instruments; these we cannot here discuss, but the simple plan known as the "jury mast" system is very generally efficient, and can be carried out by any surgeon or dresser.

Its main features can be seen in the accompanying figure. (Fig. 153). It consists of a light plaster jacket, from which springs the mast itself, which is a light bar, with a joint for the adjustment of its length, arching overhead, and having a cross-yard about 5 inches long, from which hang straps to support the head from the chin and occiput.

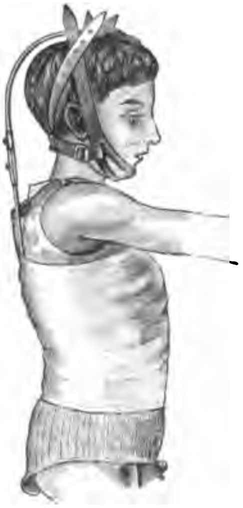

FIG. 153.—*Jury Mast applied.*

Shape of mast.

The mast is forked below, so as not to press upon the vertebral spines, and has attached to it thin strips of tinned iron, with pierced rough holes; these go round the body and are worked into the plaster jacket.

Fitting and application.

In fitting the mast, the iron bar should first be bent with wrenches to the right shape, and then tempered. The exact height may be afterwards adjusted.

The jacket may be put on with, or without, suspension, as may seem best, but if the tripod be used, the greatest possible care must be taken not to put too much strain on the vertebræ of the neck. The plaster jacket must be as light as will fix the mast, which with the cross strips, is imbedded in its substance, having layers of plaster both above and beneath the iron.

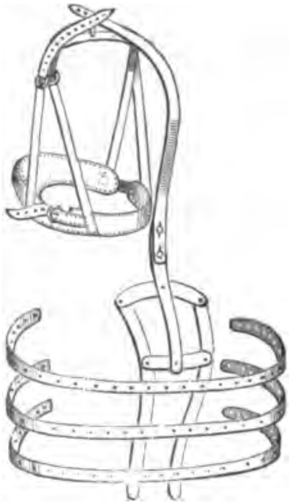

FIG. 154.—*Jury Mast Frame.*

As soon as the jacket is set, the straps may be adjusted, and the length so fixed that the bar is just clear of the head, when the latter is supported to the extent which gives greatest relief. This height will have to be altered from time to time.

Although this apparatus would be almost insupportable to people in health, it can be worn with comfort in cases of cervical caries, where the relief it affords is often very great. The curve of the mast in Fig. 154 is hardly bent enough to the shape of the head and neck.

The Author has recently applied the mechanical principle of the jury mast to cases of caries of the upper dorsal spines, with good results. In certain forms of this disease the angular deformity is of such a nature that the shoulder girdle and upper part of the chest drop more and more forward until the hands rest upon the knees (see Fig. 155). This deformity continues to increase even when the active carious process has been arrested, for there is no tendency to any compensatory lordosis lower down in the healthy parts of the spine, as occurs in many other varieties of dorsal caries.

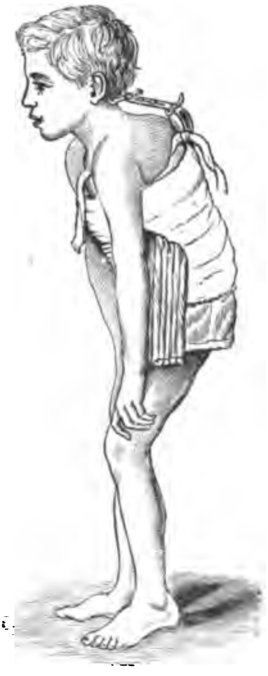

FIG. 155.—*Jury Mast for upper Dorsal Caries before the Bands are fastened.*

No form of jacket will of itself give the requisite support, but if a jury mast be attached over the last eight dorsal and the lumbar vertebræ by means of a light plaster case, as in the case of cervical disease, and if it be bent opposite the angular deformity so that the upper free part overhangs the spine above this angle, stopping short at the back of the head, as shown in the figure, it will then be easy to sling up the drooping chest and shoulders to two cross-bars pivoted on this free part by means of a couple of padded axillary bands, and a broad webbing strap.

The figures 155, 156, illustrate this arrangement before and after the bands are tightened up. The webbing chest support is best fastened by sewing short tin strips to it, (indicated by dotted lines in the figure 156) and attaching these to the jacket by a turn or two of plaster bandage.

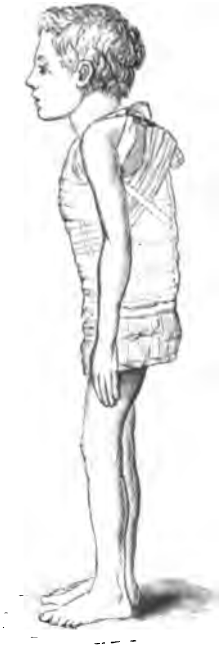

FIG. 156.—*Jury Mast, etc., as in* Fig. 155, *after the Bands are fastened up to the Cross Pieces.*

In other cases a light felt jacket may be used instead of the plaster one. There must always be a good hold taken of the pelvis.

Returning to the question of support in cervical disease, in addition to the jury mast plan one or two others should here be mentioned. Thus Mr. Furneaux Jordan (*loc. cit.*

p. 299) has recommended a plaster support which fixes the whole spinal column, absolutely preventing rotation, and which, therefore, should be more suitable than the ordinary method, for caries of the two first cervical vertebræ. The apparatus essentially consists of a plaster of Paris figure of 8; the upper loop embraces the forehead and sides of the head, the decussation is at the seat of the disease at the back of the neck, and the lower loop encircles the root of the neck; the ends of the bandage which has formed the 8, are then attached over the front of the chest to a light plaster jacket.

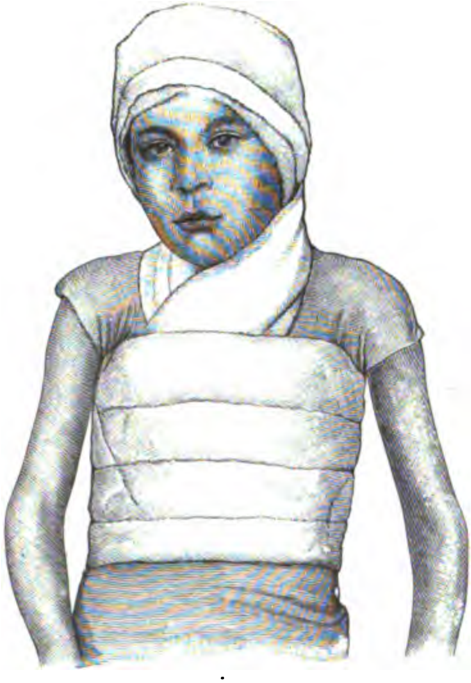

FIG. 157.—*Furneaux Jordan's support for high cervical caries.*

The method of application is as follows: The patient must lie on a flat, hard couch or table, with the arms raised over the head. The head itself must either be steadied by an assistant, or (as advised in Mr. Jordan's original paper) extended by a weight and pulley. In either case, pads of cotton wool or lint must first be placed over the ears, at the back of the neck, and over the collar bones, and these must be secured by a flannel figure of 8 bandage, put on in the same way as the plaster bandage will be, which is to lie over it, and a cinglet is to be worn over the body.

Extension may generally be dispensed with, but if it is to be employed a chin and occiput sling must be made by adjusting an ordinary four-tailed bandage below those parts, or attaching two strips of adhesive strapping in a similar fashion. In either case the ends of the sling must be brought together over the head and attached to a cord, which, passing over a pillow at the head of the couch, has there a weight of 3 or 4 lbs. attached to it (Fig. 158).

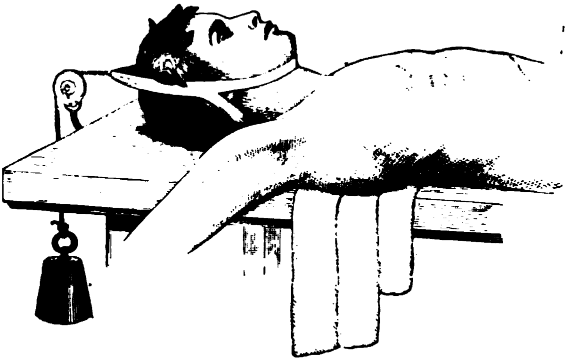

FIG. 158.—*Furneaux Jordan's arrangement for extension of head.*

A strip of household flannel, two inches and a half wide, and of sufficient length, is soaked in a basin of plaster of Paris cream. The centre of it is then applied to the patient's forehead, and the ends are brought round from before, backwards on either side over the ears to the back of the head; the two ends are crossed there over each other, and are then continued forwards over the front of the root of the neck, and either approach or cross each other again upon the sternum. Another strip of flannel soaked in plaster must then be put round the chest over the ends of the figure of 8 bandage. A second and third bandage are then applied to the head and neck as before, and enough flannel strips are put round the chest to make a light jacket for the thorax, into which the strips are firmly incorporated.

If the chin and occiput sling has been used, it can now be cut away.

Mr. Walsham, in a paper read before the Medical Society[*] advised the use of a poroplastic jacket and collar combined. Dr. Fleming, lastly, has invented an india-rubber inflating bag (Fig. 159) which when adjusted over a broad stiff collar of felt, and distended with air, supports the head, and extends the neck.

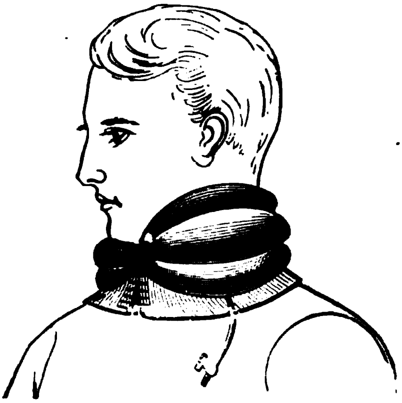

FIG. 159.—*Dr. Fleming's India-rubber Inflating Bag.*[†]

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[*] *Brit. Med. Journal*, 1885, Vol. I, p. 701.

[†] *Vide The Glasgow Medical Journal*, May, 1884.

CHAPTER XXIV.

OF GENU VALGUM, TALIPES OF THE FOOT, ETC.

Of Genu Valgum or Knock-Knee.

Genu valgum or knock-knee. Putting aside those cases in which some operation about the femur, or about the knee joint seems to be advisable, much may be done by a patient use of the simplest forms of splints; in very young children especially, quite as much, and probably more, than can be effected by the most expensive forms of instruments.

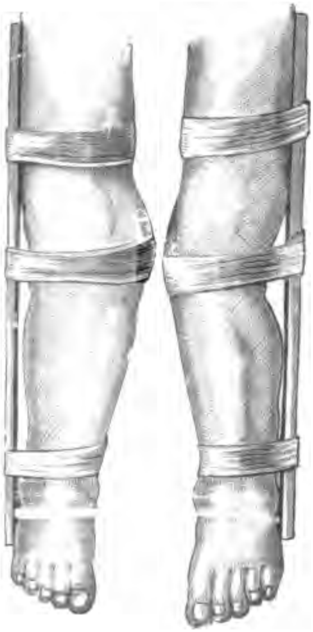

FIG. 160.—*Splints for Genu Valgum. (The strapping or webbing is not sufficiently broad in this cut.)*

Treatment by simple splints. For most cases, two outside splints of a simple pattern, as those which are shown in the figure (Fig. 160) will be found quite efficient. These may be fastened on by webbing straps, or by broad strips of strapping. In either case one strap, or strip of plaster, must always go over the knee. Long, thick stockings had best be worn beneath the splints, or a flannel bandage may be applied instead; a calico bandage may be put on over all if the webbing or strapping fails to fix the splint firmly enough.

In bad cases, or ones which are quickly getting worse, it is best to wear the splints continuously, only taking them off night and morning for readjustment.

But in slight cases, or in those which are on the road to recovery, free movement in bed may be allowed, and the splints put on the first thing every morning.

By plaster of Paris.

Another plan, is to put up the legs in light plaster of Paris cases, stiffened if necessary by a wooden splint on the outside. While the plaster bandages are being put on, the knock-knee must be forcibly straightened as much as it will bear. The new position of the limb will be retained by the splint, and when this has been worn a short time (say three weeks), it may be taken off, and a further forcible straightening effected and retained in the same manner.

Valgus of the knee is often associated with that of the foot. Which may be the cause, and which the effect, is a much disputed point; but in any case both conditions must be attended to.

Bandy legs.

Bandy (or bowed) legs, curvature of the tibia, etc.—Simple bandy leg, or general outward curvature of the tibiæ, inasmuch as it is nearly the reverse of knock-knee, may be well treated on just the same lines, the splints being put on the inside instead of the outside of the legs. This condition yields to treatment more readily than valgus of the knee.

Rickety curvature of tibia.

The curved tibiæ which occur as a consequence of rickets, are now far more frequently treated by section of the bones with a saw or a chisel, than formerly was the case. It seems to be established, that if it be properly performed, the operation is practically free from danger; and although the ultimate results upon the growth and nutrition of the bones can hardly be determined absolutely at this time, all the evidence points to there being no important disturbance of these processes.

Treatment by splinting.

But the number of rickety legs which can be improved or cured by proper splinting, will always be very large as compared with those in which osteotomy is at all called for, and common light wooden splints are infinitely preferable to "irons" of any kind.

The length and method of attachment of these splints will depend a good deal upon the stage of the disease, and upon the age of the patient. In the acute stage of the rickets, and especially if the children are quite young and are only just beginning to "feel their feet," it is best to keep them from bearing any of their weight, often increased by a tumid belly, and a heavy head, upon the yielding leg and thigh bones. In this case the splints had better be worn day and night, always being adjusted morning and evening. They must be well padded, and should extend three or four inches below the foot, being attached by bandages or webbing straps, and generally to the inside of the limb. If this length does not succeed in keeping the child off its feet, they may be made of different lengths, and if this fails, the legs must be tied together, or some such plan as was described in the chapter on hip disease, must be adopted. (See Fig. 140.)

1. When the patient is not to walk at all.

2. When walking is permitted.

But if the rachitis be not acute nor the curvature very great, it is generally wise to allow the child to run about, the splint extending to the bottom of the foot only (Fig. 161).

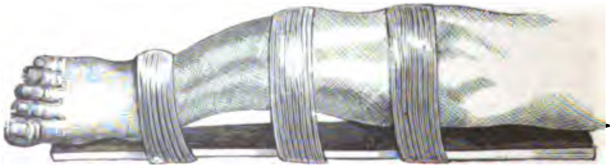

FIG. 161.—*Simple Splint for Bandy-leg, attached.*

As a rule, webbing straps and buckles are here better than strapping or bandaging. A broad strap should always go round the place of greatest curvature.

As a rule, these splints are best put on the inside of the leg, but there are frequent exceptions, and it is often advisable to change about from one side to the other to avoid sores over the malleoli, etc.

As the improvement continues, and the bones consolidate, the splints may be left off at night and finally abandoned altogether.

Treatment by plaster of Paris.

Here, as in the case of knock-knee, plaster of Paris can be very usefully employed. The best way is to attach a wooden splint so as to keep up a constant straightening force when it is fixed by the plaster. The case should be as light as possible, so as not to interfere with the nourishment of the limb.*

Club foot.

Of Club Foot.

The different kinds of club foot are very numerous, and the cases of each variety of the deformity, differ very much among themselves in the extent to which they are amenable to treatment, and as to whether one plan of treatment or another is the more suitable.

Classification of forms of talipes

Without entering into the pathology of the condition, the following forms of club foot may be taken to be those with which the house surgeon and surgical dresser may expect to have to do.

I.—Slight forms of Weak Ankle and Flat Foot.

Varus.	*Valgus.*
II. *Varus* + *equinus* or *cavus* (generally + both) and *equinus* only, with little displacement of bones and not requiring tenotomy.	VI. More severe forms of valgus and calcaneo-valgus, not paralytic.
III. *Varus* + *equinus* + *cavus*, requiring tenotomy, division of fasciæ, etc., (bones not permanently displaced or deformed).	VII. Valgus + calcaneus, paralytic.
IV. *Equinus* only, requiring tenotomy.	VIII. Calcaneus only, paralytic, or due to non-union of the tendo Achillis after division.
V. *Varus* + *equinus* + *cavus*, with marked bony distortion, not curable by tenotomy, splinting, etc. (treatment belongs to major surgery).	

Slight forms of weak ankle.

I. *Slight forms* of what is generally called "weak ankle" are very common in children; sometimes the foot turns inwards as a persistent condition resembling the slight varus with which all infants are born; but more commonly, the tendency to a slight valgus, with a flattening of the arch of the foot, and a little slip forwards of the astragalus over the ridge of the sustentaculum tali.

In either of these conditions the aim should be to brace up the ligaments and muscles as much as possible, and to this end shampooing, bathing with salt and water, galvanism and other measures to improve the nutrition of the parts, are all good, while anything in the shape of irons, which cripple the limb under the pretence of keeping it straight, is bad.

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* As a preventive measure against bowed legs, and other infantile deformities, the usefulness of the old-fashioned "go-cart" should not be forgotten. The modern perambulator is in many respects a change for the worse.

The legs should be kept warm, and light shoes, not boots, be worn.*

Oblique heels.

In these slight cases a good deal may be done by alterations in the pattern of boots which are otherwise of the ordinary kind; thus the heels of the shoes may be cut obliquely, so as to slope, in the case of the valgus foot, backwards and outwards across the sole; in the varus form in the reverse direction, an angle of about 45 degs. being a good general direction. The boot sole as well as the heel may also be made thicker on the one side than on the other, so as to throw the foot over in the direction opposite to that in which it naturally turns.

Valgus pad for sole.

Another expedient is only used for valgus, and consists in fixing a pad or plate under the sole of the foot, in the shoe, so as to support the plantar arch. One pattern of such a pad is shown in Fig. 162, and another and a better form in Fig. 163, where an india-rubber pad is shown by itself, and also in the position in which it should be attached to the inside of the boot so as to support the instep.

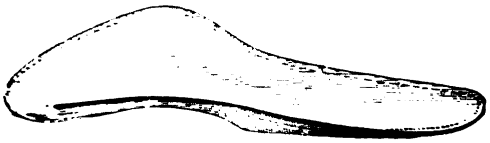

FIG. 162.—*Valgus Sole-plate.*

Varus, generally with cavus or equinus, not requiring operation.

II. Not quite so common as this condition, but still very frequently met with, are those varus club feet, which are almost always associated with a contraction of the plantar fascia, and with some degree of equinus, but in which the whole deformity is slight, and yields to treatment without the division of any structures.

The beginning and the end of the successful treatment of these cases is patience, and, again, patience, in the keeping of whatever contrivance may be selected, properly adjusted to the foot and legs; and the same may be said of unconfirmed cases of simple *equinus*.

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* We believe that the best kind of shoe in these cases is that known as the "Flexura," the special feature of which consists in the working of a metal spring into the sole.

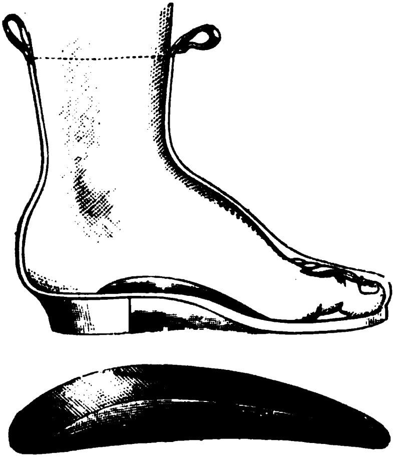

FIG. 163.—*India-rubber Valgus Pad, in position and separately.*

Requires same treatment as the more severe cases *after* operation.

It will not, however, be necessary to distinguish or describe the various plans for the remedy of this grade, separately from those for the third one, where the tendons call for division, for practically the whole treatment of the former is identical with the after treatment of the latter degree of club foot, which is now to be considered.

Varus and equino-varus.

III. *Talipes varus* and *equino-varus*, both of which conditions are generally associated with plantar contraction, may be from the first, and, if neglected, will in all cases become, complicated with such an amount of contraction of the tendo Achillis and of the tendons of the anterior and posterior tibial muscles, etc., that division of some of these structures will be necessary before the deformity can be remedied. It is, however, often desirable to carry out a preliminary course of splinting, etc.

In the chapter on Minor Operations we shall refer to tenotomy, although only very briefly. As a rule these operations present little difficulty, yet some cases are troublesome, and all require practice to do neatly. Fortunately, this is one of the few operations which can be done on the dead body, owing to rigor mortis, with a rather close imitation of the conditions during life, so that every student should have abundant opportunities of acquiring the necessary skill.

Tenotomy only one step towards cure.

The mistake is too commonly made of supposing that the tenotomy once performed, the club foot is cured; on the contrary, the division of the tendons should only be regarded as a necessary preliminary to the real curative treatment of the deformity.

We will suppose then that the necessary tenotomies have been performed, or that none have been required, and that in the former case the foot has been allowed to remain undisturbed for three or four days.*

One of the following lines of treatment should be chosen.

(1.) Persistent splinting with stiff, straight splints.

(2.) Persistent splinting with a stout but flexible metal splint.

(3.) With some form of Scarpa's or Adam's shoe.

(4.) With a plaster case.

(5.) By a combination of flexible metal with plaster.

The choice of plans.

Any of these plans, in proper hands, will succeed, if the case be favourable; on the whole, we believe No. 5 to be the most, and No. 3 (the shoe) the least satisfactory, but it would be quite improper to dogmatise.

By a stiff straight splint.

1. *By a stiff straight splint.* A well padded wooden one is the best to use, not broader than the leg, and long enough to reach from the knee to below the foot. The limb should be attached to it either by bandages, or strapping, or by webbing straps, or by a combination of these. For very young children, strapping applied over a flannel bandage is best.

The splints should be taken off and readjusted at least once every twenty-four hours, and when they are off, the opportunity may be used for shampooing, galvanism, etc. This direction must be taken to apply to all other removable apparatus to be presently mentioned.

By a flexible metal splint

2. *By a flexible metal splint.* A cure of the club foot can be effected by means of a stiff splint, but a more comfortable plan in most cases, is to use straight metal splints, flexible enough to be easily moulded, and sufficiently stiff to retain the shape to which they may be bent. By their use the

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* Although some surgeons advise the immediate fixing of the foot in good position after tenotomy by plaster of Paris, and although, no doubt, good results may follow this practice, still it is attended by a certain risk of non-union of the tendon.

deformity may be gradually corrected, as shown in the figure (Fig. 164). The splints should be put on over flannel bandages, and strapping or webbing, etc., used as before.

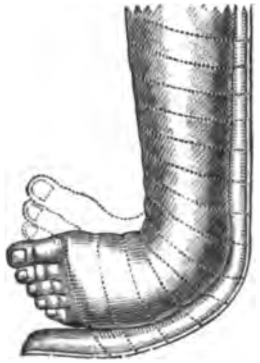


FIG. 164.—*Use of Flexible Metal Splint (diagrammatic).*

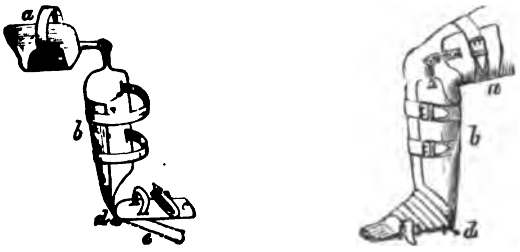
These also have to be taken off at intervals, as was directed for the stiff splints.

By a Scarpa's shoe.

3. *A shoe*, Scarpa's or some modification of it, is still largely employed (though not quite so generally as heretofore), more especially in the later stages of the treatment. In Figs. 165, 166 a good form of shoe and the mode of its application are shown, and no further description is called for. In all the varieties of this instrument, expense is a great drawback, and it is absolutely essential to have the shoe of the right size.

Principle of the shoe treatment.

The principle of the shoe treatment, is to adjust the angles of the instrument to those of the deformity, and then, after fastening the foot and leg firmly into it by



FIGS. 165, 166.—*Adam's modification of Scarpa's Shoe.*

straps, to gradually bring the parts into position by turning day by day, but very slightly, the rack and pinion hinges, or other contrivances for altering the direction of the sole (varus), and the angle of the foot (equinus). These shoes will have to be readjusted very frequently, and the flannel bandage, which should always be put on the limb under the shoe, taken off, so that the slightest commencement of a sore may be observed; these are very apt to form, especially over the heel.

Care of the heel.

The greatest practical difficulty in this method, is the keeping the heel down into its place in the shoe. Unless this be done, every turn of the rack and pinion will only lift it a little more, and no good will be effected. This is a very common oversight, and is of itself a sufficient reason for frequent readjustment.

It will be gathered from the above that the treatment by Scarpa's shoes is a troublesome one, and though success will often repay the daily care required, it will never be a favoured method with hospital dressers.

With a plaster case.

4. A plan of treatment which is now coming into very general use, is to put up the foot and ankle in a plaster of Paris case, while the foot is held in as good position as possible. If tenotomy has been performed, the limb may be put up immediately after the operation, or three or four days allowed to elapse.

Plaster case with metal splint.

5. But a better plan than the simple plaster case is the modification shown in Figs. 167, 168, for a knowledge of which the author is indebted to Mr. Churchill.

The splinting is performed in the following way: a piece of broad webbing is cut of a length sufficient to go round the foot at the instep, and its ends are sewn together. A flannel bandage having been applied to the foot and leg, this webbing band is slipped over the foot. A strip of tinned iron, a half or three-quarters of an inch wide, and a little longer than the patient's leg, is then bent round the sole of the foot as shown in Fig. 167. The strips must have holes punched roughly, to allow of the lower end being sewn to the webbing, and to enable the plaster to hold better.

When the strip is adjusted, it can be used as a lever to straighten the foot, by being held along the leg, as shown in the figure, and then must be fixed in this position by a plaster of Paris bandage, which may be quite light. In this way there is a constant spring on the foot, to force it outwards in the right direction.

Having now discussed the management of the different degrees of club-foot of the various types which are amenable

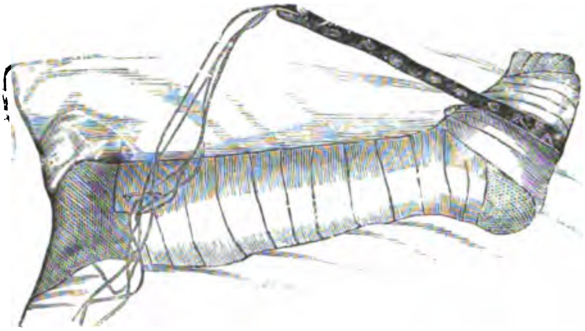


FIG. 167.—*Plaster and Flexible Metal Splint combined (First Position).*

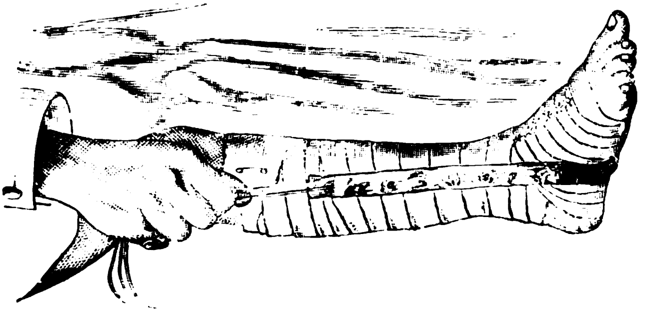


FIG. 168.—*Plaster and Flexible Metal Splint combined (Second Position).*

to mechanical treatment, with or without tenotomy, we shall be able to consider the remaining kinds and degrees of talipes which are mentioned in the list on page 329, much more briefly, for some should be treated on the same principles as the foregoing, and others, especially those which are due to distinct paralysis, are hardly capable of any improvement.

Of equinus only requiring tenotomy.

IV. Cases of confirmed equinus without any other deformity are not very common, but are not difficult to treat. The tendo Achillis having been divided, the foot and leg may be put in a Scarpa's shoe after an interval of a few days, and the heel gradually brought down, or a flexible splint may be applied to the inner or the outer side of the limb, so as to produce the same result. It is not advisable to fix the foot in the proper position by means of plaster of Paris at once, lest the tendon should fail to unite.

Of varus, etc., with great bony deformity.

V. When the bones of the tarsus are so distorted and ill-developed that by no ordinary division of the soft structures can the sole of the foot be brought flat, or nearly flat to the ground, the removal by operation of a wedge-shaped portion of the tarsal arch has been practised with success. The operation itself is a severe one, but the after management of the case, does not differ materially from that of slighter deformities in which tenotomy has been performed. This treatment, of course, is only to be adopted when all milder measures are obviously hopeless, or when they have been tried and have failed.

Valgus and calcaneo-valgus, not paralytic.

VI. Valgus and calcaneo-valgus—too severe to be classified as simple flat foot—but which are not paralytic, are rare. They must be treated on the same general principles as grades II. and III. of varus club foot, which have been described.

Of valgus, and calcaneo-valgus, due to paralysis.

VII. But in the great majority of cases, high degrees of valgus and calcaneo-valgus are caused by some form of spinal degeneration (usually by infantile paralysis). Very little can be done here by the surgeon, beyond the adoption of general measures to maintain the nutrition of the muscles affected, and to prevent the increase of deformity. These cases, moreover, differ so widely one from another, that general directions can be of little use. But we may say that tenotomy is almost always to be avoided.

Of simple calcaneus, paralytic or through non-union of tendo Achillis.

VIII. Something, however, can be done mechanically, for cases of simple calcaneus, even if it be due to paralysis, and still more if the cause be a non-union of the cut ends of the tendo Achillis, after its division by the surgeon, or as the result of injury.*

Artificial tendon.

In these non-paralytic cases, it is often feasible to unite the ends by a planned operation; but putting aside this procedure, whatever the cause of the calcaneus may be, a useful artificial tendon may often be made by attaching an elastic spring to the heel of the boot below, and to a metal hoop encircling the calf above, which is riveted to an upright, hinged at the ankle and springing from the sole of the boot.

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* The possibility of non-union, is a strong argument against dividing this tendon in cases of fractures of the leg, when it is difficult to get the fragments into good position.

Much of the ordinary work of the calf muscles may be supplied by such an arrangement, which any instrument maker can easily construct. The spring itself is best made of three or four lengths of woven elastic, such as is used for garters.

Twisted toes.

Twisted toes.

The dresser will sometimes have his ingenuity taxed by cases where one toe, generally the middle one, persistently bends down between its neighbours, and is compressed by them. These toes are very obstinate, and often exhaust the patience of the surgeon. Some form of glove for the three toes concerned, which must be stiff enough to hold them straight, combined with very roomy boots, will be generally found the best treatment.

Hallex valgus

Hallex Valgus. The great toe is frequently deflected or twisted outwards, displacing the other toes, or riding over or under them. This deformity is generally due to bunion, or to some inflammatory enlargement of the parts concerned in the metacarpo-phalangeal articulation. It is generally progressive, and is a common cause of ingrown toe-nail (*q.v.*).

Relief may often be afforded, by protecting the prominent joint from pressure, by attention to the shape of the boot, and by the use of a pad of adhesive felt, as in the case of corns, but the condition is difficult to cure except by the radical method of excision of the joint, or the removal of a wedge from the metacarpal bone as recommended by Mr. Arthur Barker. But moderately severe cases may be successfully treated by a splint, such as is shown in Fig. 169, invented by Dr. Spitta.* It will be seen that the correction

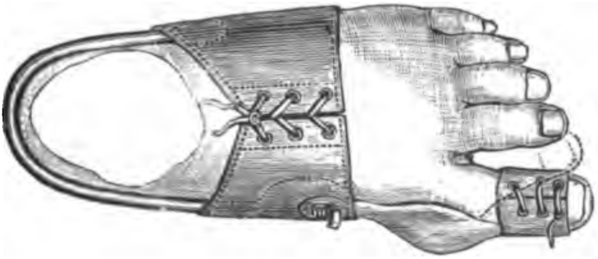

FIG. 169.—*Dr. Spitta's Splint for Hallex Valgus.*

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* *Brit. Med. Journal*, 1885, Vol. I., p. 1110.

of the deformity depends upon the action of a rack and pinion. Another and cheaper apparatus is described by Dr. Neale[†] as being an old device. It consists of a tin plate cut to the natural shape of the foot, and riveted to a cork sole. Slots are then cut in this, in such places that the toes can be retained in their proper positions by tapes passed between them.

[†] *Brit. Med. Journal*, 1885, Vol. I., p. 1205.

SECTION VI.

OF CERTAIN EMERGENCIES, SURGICAL AND GENERAL.

CHAPTER XXV.

OF SURGICAL EMERGENCIES, AND ESPECIALLY OF THE RETENTION AND EXTRAVASATION OF URINE.

General considerations.

IN any large general hospital it is a matter of almost daily experience that cases of disease or injury present themselves in which the condition of affairs is such that immediate action must be taken; and it will sometimes happen that it is not possible for the resident medical officer to obtain the attendance of one of the visiting staff sufficiently quickly to be of any use. The experience that a house surgeon acquires during his term of office as to the management of these "cases of emergency" forms perhaps the most valuable part of his training—for many other qualities besides theoretical or book-learnt knowledge are called into play—readiness, tact, firmness, self-restraint, and self-confidence, every quality that enables a man to take the lead, to govern, and to direct, may have to be shown, and shown at a moment's notice.*

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* We have some apprehension, lest, in this, and the preceding chapter more especially, we may seem to unduly consider questions concerning major surgery. But what is here written has been deemed necessary for the explanation of the practical measures we advise. It must however be most clearly understood that in all matters of treatment the house surgeon's place is the second one, and that his chief work consists in the carrying out of the instructions of his senior.

It is quite impossible to draw any line within which he may feel free to exercise his own responsibility, for the rules at different hospitals vary, and much will depend upon the length of service and

The emergencies that we propose to deal with in this present section are those which commonly occur in hospital casualty practice. Many of them are strictly surgical, such as the retention of urine, but we shall not confine ourselves to these, but will endeavour to include in our list the majority of those conditions of urgency, which may rightly claim immediate attention at the hands of a qualified medical officer; but it must be understood that we shall here consider only the measures to be taken for the relief of the urgent condition, not those which may be advisable for the treatment of whatever disease may be its cause.

Division of the subject.

We shall take first those surgical emergencies which arise from the retention, or the extravasation of urine, from intestinal obstruction and the like, and in the two subsequent chapters we shall discuss those urgent conditions caused by some general disease, such as the occurrence of fits, and the appropriate management of cases of poisoning, drowning, etc.

Surgical emergencies. The chief kinds.

Surgical Emergencies.

The strictly surgical emergencies which we have to consider are those which arise from obstruction, by disease or injury, to the passage of urine, or from intestinal obstruction, commonly caused by the strangulation of a hernial protrusion.

Retention of urine.

Cases of obstruction to the flow of urine, "retention cases" as they are termed, form a class which probably gives house surgeons more anxiety than any other, and certainly no subdivision of surgical practice can show a worse record of damage done through careless or ignorant treatment.

In considering this question we shall confine ourselves

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personal experience of the particular officer; for example, in a case of retention of urine, with a practically impassable stricture, a house surgeon, recently appointed, should not proceed beyond a fair attempt at catheterisation before he sends for help, while another who has served a year or more, may be justified in going on to aspiration of the bladder.

Still, to the following rule there can be no exception:—*In all cases of doubt the house surgeon must send for the visiting surgeon at once,* and if the case be urgent he can but do his best in the meantime, adopting curative or temporizing measures, whichever seems to him to be right.

We have discussed some measures which border upon major surgery, such, for example, as deep perineal incisions, chiefly because they are the logical sequence of the failure of less severe proceedings, and in order that the junior surgeon should not feel as if with these failures the end of all resources had been arrived at, although the operative steps themselves are most frequently undertaken upon the advice and under the direction of his senior.

strictly to the fact of the retention, leaving alone the means, operative or otherwise, which the visiting surgeon may adopt for the cure or alleviation of its cause.

From stricture with spasm.

We may take first, as an illustrative case of retention, one which is very common in hospital practice, namely, where a patient, the subject of a long-standing stricture, suddenly, in consequence of alcoholic excess or of exposure to cold, is attacked by additional congestion and spasm of the urethra, sufficient to produce complete retention, whereby in a few hours his sufferings become so great that he must be relieved without delay.

In such a case no one line of treatment is to be recommended to the exclusion of all others, but the surgeon's decision must be founded on what he can learn of the previous history of the disease.

In chronic, but not tight, stricture.

If he find that the patient is a regular "stricture case," in the habit of passing a catheter on himself, or of having it frequently passed, the probability is that no great difficulty will be encountered in introducing a silver or flexible instrument, and the attempt may rightly be made to give instant relief in this way.

When spasm is the chief agent.

But suppose that, on the contrary, no noteworthy difficulty has been experienced by the patient previous to the retention, and that the urine has hitherto been passed in a fairly full stream? Here we probably have to do with a case of stricture, insidiously contracting, in which *spasm* is playing a more important part than the organic constriction. For this reason it will be wise (although immediate catheterisation is frequently performed) first to take measures to reduce the irritability of the urethra. These will often be sufficient of themselves to procure relief, and in any case the condition of the parts will be then much more favourable for an easy passage of an instrument. The patient should at once be placed in a bath, hot enough to produce general relaxation (of a temperature that is from 102° to 104° Fah.), and must remain in it until the skin acts profusely. If, as often happens, the urine be passed while the patient is in the bath, so much the better, but failing this occurrence, he should lie between blankets, and an enema of starch, or of warm water, with the addition of ♏ xx of laudanum or of the liq. opii sedativus may then be given. A hot linseed poultice, to which a little mustard may be added, should be applied to the hypogastrium.

In the great majority of cases the patient will now be able to pass his water freely enough to get relief, but if not, the circumstances are much more favourable than before for successful catheterisation, and even supposing that the retention still continues obstinate, and that no instrument can be passed, relief can always be given by puncture of the bladder through the rectum, or over the pubes (*q.v.*).* But in the class of cases we have hitherto considered, this will very rarely indeed be necessary.

When the stricture has been neglected.

For somewhat different reasons the immediate use of the catheter should not be resorted to, in those cases where from the history it appears that the stricture has through neglect been allowed to go on steadily contracting until the canal of the urethra has become almost obliterated, so that a very slight additional congestion is sufficient to produce retention.

These cases are very hard to treat, and often require urethrotomy for their permanent cure, but this operation is hardly ever performed for the relief of the retention itself, and should never be by a junior medical officer.

In these patients, catheterisation will, even under the most favourable circumstances, be difficult enough, and it is therefore wise to adopt the measures for the relief of the spasm and congestion, which have just been mentioned, before any attempt is made to pass an instrument.

Whatever the character of the stricture may be, it will sometimes happen that no catheter can be got through it; and supposing that the hot bath, poultices, etc., have failed, and also that a patient trial has been made with the various kinds of catheters, bougies, etc., without success, what is to be done?

Aspiration, when necessary.

We advise that the patient be now placed under the influence of an anæsthetic, and that a final attempt be made to pass an instrument. Failing this, the bladder should be aspirated above the pubes with a moderately fine aspirating trocar, in the manner to be afterwards described. The retention once relieved, opportunity will be given for the subsidence of spasms, etc., so that it often happens that the urine is subsequently passed in the natural way, or that an instrument can be got in.

In any case time will have been gained for consideration as to the best surgical treatment, and the case will have passed out of the category of emergencies.

Retention from enlarged prostate.

We have hitherto considered those cases only in which the retention has been due partly or entirely to an organic stricture of the urethra (for a purely spasmodic stricture, capable of producing serious retention, must be ranked only among the curiosities of surgery, if it ever has really occurred). We come now to a different kind of retention, that, namely, which is caused by an enlargement of the prostate gland, and generally, of its middle lobe. With regard to this form, no warning can be too strongly worded as to the vital importance of recognising the cause of the retention, and of not mistaking the case for one of stricture to be relieved by catheterisation with small metal instruments of an ordinary length and curve.

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* The details of catheterisation, of puncture of the bladder, etc., are described later in the section on Minor Surgery.

Never to be mistaken for stricture.

Such a warning may seem altogether uncalled for and gratuitous, and so we suppose it should be; but that it is not, is a matter of common knowledge, and every surgeon sees only too many patients whose urethras bear witness of how dangerous a weapon a No. 2 or 3 silver catheter is, in ignorant or heedless hands.

Dribbling overflow commonly present.

These cases of enlarged prostate are rarely attacked with sudden or *absolute* retention, but very often suffer from a condition hardly less serious, namely, an over-distention and partial paralysis of the bladder walls, in which event the organ is only saved from bursting by a constant dribbling or overflow, which brings but little relief.

The general history of the case.

Whenever a patient over the age of 50 or 55 presents himself with the history that he has had increasing difficulty in emptying the bladder for some time past, and that now he can only pass a few drops after much straining; and when, in addition, it is found that the bladder (not necessarily large) is obviously full, the case is almost certainly one of retention from enlarged prostate, and an examination should at once be made by the rectum to establish the diagnosis.

In the more troublesome of these cases, the paralytic condition is the chief agent in the retention; in others there may be temporary congestion of the urinary passages, as in the case of stricture, while, of course, we may have to do with mixed cases of prostatic enlargement *and* stricture.

The measures for relief.

When the retention is recognised as being due to an enlarged prostate, the immediate relief is not generally difficult, provided the case has not been already complicated by improper attempts at catheterisation, and there will be, as a rule, little difficulty in passing a full sized instrument (Nos. 10 to 12).

This may either be a silver "prostatic catheter," *i.e.*, one which is longer and which has a much bolder curve than the ordinary pattern, or a flexible catheter of the usual form, or if the middle lobe should prove unusually difficult to surmount, an elbowed one (*coudé*) may be used, or resort may be had to some of the manœuvres which will be mentioned apropos of the practice of catheterisation.

Puncturing the bladder. It should very rarely be necessary to puncture the bladder for enlarged prostate. If this has to be done, aspiration above the pubes is to be preferred.

After management. Although the immediate relief of the retention in cases of enlarged prostate is not generally very difficult, the after management is always troublesome. The recurrence of the retention should, if possible, be avoided, the tone of the bladder walls improved, while that low form of cystitis, which is almost always present, calls also for treatment. By regularly emptying the bladder with a soft catheter, by washing it out, etc., much may be done for the patient's comfort, but the cause being irremediable, the treatment can only be palliative.

Finally, we repeat, that in very many cases we believe the immediate use of the catheter *for the relief of retention*, to be unwise, and that it will often not be required at all, if proper measures for the diminution of local spasm and congestion are promptly adopted; and further, that it often happens that a patient has eventually to be subjected to the operation of puncture or aspiration of the bladder, who would never have required it but for injudicious attempts to pass instruments upon the first opportunity.

Retention from phimosis. In children it may occasionally happen that a tight phimosis may become inflated and œdematous, and the urine may be unable to escape. In such a case, dilatation with a director and a pair of dressing forceps will secure a temporary and perhaps a permanent relief. (See 'circumcision,' in Section on Minor Operations.)

Retention from impacted calculus. Another cause of acute retention also occurs more frequently in children than in adults. This is the impaction of a small calculus in the urethra. In such a case it often happens that the arrest takes place sufficiently near the meatus to enable a fine pair of specially-constructed *urethral forceps* to seize and remove it.

If the fragment lie further back, so that the forceps will not catch it, but where it still can be felt easily through the tissues, a careful incision made absolutely in the middle line, should allow it to be readily removed, and the wound may be expected to heal almost directly. But if it should be lodged near the neck of the bladder, any operation for its removal will be a more serious matter, and one not to be reckoned as "Minor Surgery." We will, therefore, only mention that the course commonly advised is to try to push the stone back into the bladder, by passing an instrument, and then to take a favourable time for its removal by cystotomy.

Retention following shock, operations, etc.

It not unfrequently happens that the shock of an operation or of an injury, especially if the abdominal or pelvic viscera are concerned, produces an atonic condition of the bladder walls, and therefore a transient retention of urine. So commonly is this the case that almost the first question the surgeon asks at his visit, subsequent to an operation, is, whether the urine has been passed. This retention seems to occur as often in women as in men, and is especially common in children.

Occurs in both sexes.

In most cases a little patience, and the application of a hot poultice or fomentation to the hypogastrium and perineum, will be followed by a natural contraction of the muscular coats of the bladder, but if not, a catheter must be passed before extreme distension takes place.

Hysterical retention in women.

With the exception of this and one other form, retention of urine in the female occurs so rarely that we need not consider it. The other form we allude to is *hysterical retention*. This mode of self-torture is not uncommon in severe hysteria, and unless it speedily yield to moral influences may require to be treated by regular catheterisation, night and morning (which it will be wise to depute to the nurse to perform) until the habit is relinquished.*

Rupture of the urethra, etc.

Of rupture of the urethra and extravasation of urine.

The chief causes.

There are two main causes for a giving way of the urethral walls and the occurrence of extravasation of urine. The first is the infliction of some injury to the perineum; the second is due to the gradual weakening, or increasing rottenness of the tube, caused by low inflammatory changes following on an old standing stricture, with a more or less complete retention.

In both cases the extravasation is strictly a "surgical emergency" and requires prompt and decided treatment.

Traumatic rupture of the urethra.

Taking first, the cases of *traumatic rupture of the urethra*, it will be found that these are mostly caused by a heavy fall on the crutch, or by a kick or blow there, but they may be due to an incised or punctured wound. The *symptoms*

Symptoms.

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* The condition of the bladder must of course be ascertained by physical examination, whenever there is a report of the urine not having been passed, for it may happen that the condition is one of suppression, not of retention of the secretion.

pointing to an injury of the urethra, are a constant and extreme desire to pass water, with inability to do so, or at least only in a few drops, while there is a varying amount of hæmorrhage from the meatus. There will also be bruising and great tenderness in the perineum. These symptoms will indicate almost certainly that the urethra has been torn, and unless a catheter can be immediately passed, and kept in the bladder, symptoms of extravasation will soon occur. In the first place then, a very gentle and patient attempt should be made to pass a catheter, using by preference a No. 8 or 9 soft, olivary shaped one, and if this fails, a silver one, taking particular care to keep along the roof of the canal.

Management if catheter can be passed.

If a moderate-sized catheter will not pass, a smaller one may be tried, but will probably fail to get through, and the attempt must not be persisted in.

In the fortunate event of an instrument having been passed into the bladder, it should be tied in, in the manner to be described later, and the after treatment of the case may be left to the visiting surgeon. The patient will, in most cases, do well.

And if it cannot.

But very often it is not possible to pass an instrument, and in this case the wisest thing to do will be to wait for a few hours to watch the development of affairs. A poultice may be put over the bladder, and an enema of starch and opium administered.

Commencement of extravasation.

It may be that the obstruction is due to injury short of rupture, in which case the urine will presently be passed naturally; but this is unlikely, and in all probability in a very short time there will be unmistakeable signs of commencing extravasation of urine. This will be indicated by increased fulness and tenderness in the perineum, while the bladder becomes steadily more distended.

The median perineal incision.

Under these circumstances the patient should at once be put under an anæsthetic, and being placed in the lithotomy position, a deep incision should be made absolutely in the middle line, down to the urethra in the perineum. The opportunity of the anæsthesia may be used for a final attempt at the passage of a catheter.

The knife will be found to cut into tissues which have a semi-gelatinous appearance, due to infiltration with urine, which will at once begin to drain away from them, gradually relieving the bladder. No mere surface incision is to be made, but the urethra or its immediate neighbourhood must be thoroughly opened up.

A median incision made thus early will often be sufficient to prevent further extravasation, but it frequently happens that the patient is not seen until the urine has made its way into the scrotum, and may be traced, travelling along the folds of the groin upwards on to the abdomen, its progress being marked by a dusky, brawny, infiltration.*

Further incisions when called for.

In such a case the only chance of preventing the most extensive sloughing, with all the attendant risks of septicæmia, etc., is to make free incisions wherever the tissues are involved. The median one in the perineum should never be omitted, but in addition, the scrotum and penis may have to be incised in two or three places, while the same relief will frequently have to be afforded to the skin of the lower part of the abdomen. In spite of all, however, some sloughing is sure to occur, and this, with the smell caused by the constant escape of urine, generally makes it desirable that the patient should be isolated.

The best local application is a large charcoal poultice. Frequent washing and syringing with Condy's fluid, or carbolic acid lotions, will be called for, and as soon as the patient is able so to do, he should frequently sit in a bath of weak warm Condy.

Extravasation as a result of stricture.

The other fashion in which the urethral walls may give way, occurs when a long-standing and neglected stricture produces a condition of partial, or (more rarely) of complete retention. A low form of inflammatory softening of the walls of the canal takes place, and distended beyond their power of resistance in that condition, they give way; the result is a formation of urinary abscesses and extravasation. The symptoms do not differ materially from the traumatic form, save in this, that the extravasation commences as soon as the urethra gives way, whereas in the traumatic cases there is no escape of urine until the patient attempts to pass water.

Main lines of treatment.

The question of the passage of an instrument should be left to the discretion of the visiting surgeon, for as a rule, the tissues are not in a condition to allow of successful catheterisation until the operation of perineal section has been performed, and further damage may easily be done in the attempt. But there must be no hesitation or delay in relieving the extravasation by free incisions, whenever they are required, the one in the middle line of the perineum being, as before, the most important.

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* The anatomical reasons why the usual traumatic rupture of the urethra in front of the triangular ligament, is followed by extravasation into the scrotum and upwards on to the abdomen, but not down towards the thighs, are well known. But cases do sometimes occur of rupture between the layers of the ligament; the urine will then travel in a different direction. See a case reported by the Author in the St. Bartholomew's Hospital Reports, Vol. XIV., 1878, p. 291.

Prognosis bad. The prognosis in these cases is almost always unfavourable. From the nature of the disease it follows that the patient is broken down constitutionally; very probably his kidneys are diseased, "surgical kidneys," and the infiltration, suppuration, and sloughing, which result, are apt to bring about a condition of blood poisoning which is very generally fatal. In any case stimulants, such as alcohol, carbonate of ammonia, etc., and a generous diet will be required, while with regard to the local dressing, the management will be similar to that which was advised for traumatic cases.

We do not here consider the surgical questions which arise in connection with the urinary fistulæ which so often are the result of extravasation, however produced.

Rupture of the bladder. **How caused.** *Rupture of the bladder.* This accident is almost always fatal. In the majority of cases it occurs from a direct blow, or a fall, upon the hypogastrium, when the bladder is over distended, and it is almost always the case that the patient is drunk at the time, a fact which complicates a diagnosis in other respects not generally difficult. In these cases the rupture will be situated in that part of the bladder which is covered by peritoneum.

The usual signs of collapse which follow severe abdominal injuries are here well marked, and there is in addition, an intense desire to pass water, with complete inability to do so, or at most only a few drops mixed with blood are expelled; nevertheless the bladder remains obviously empty, until the tumefaction due to peritonitis renders a physical examination indecisive.

Catheter to be passed. In such a case, all the house surgeon can or need do, pending a decision as to operative interference, is immediately to pass a full-sized, and very soft catheter, well into the bladder, so that the best chance may be given for the escape of urine as soon as it passes from the ureters. It may be that the extravasation will be sufficiently limited to prevent a fatal result, if by good chance the rent involves only such parts of the bladder as are not covered by peritoneum, which, is the more likely to be the case if the injury to the bladder is the result of perforation by the fragment of a fractured pelvis. In these cases of extra-peritoneal injury the symptoms are usually much less distinctive. But in any case, further interference can hardly be other than harmful; all questions as to abdominal section, median cystotomy, or any other of the measures which have been advocated for these desperate conditions being, of course, left to the judgment of the visiting surgeon.

CHAPTER XXVI.

OF HERNIA AND OTHER FORMS OF INTESTINAL OBSTRUCTION.

Rupture with symptoms of obstruction.

CASES of rupture, with symptoms of obstruction more or less marked, are of very frequent occurrence in any large hospital, and the proper discrimination of the different kinds and degrees of this condition is a most difficult and responsible part of a house surgeon's work. It is true that, in London at any rate, the actual herniotomy is usually performed by the visiting surgeon, but this may be the simplest part of the whole treatment, while the house surgeon has to decide upon points which are often obscure, such as whether the question of operation ought at once to be raised, or whether taxis should first be tried, and if so, for how long, whether a preliminary bath should be given, and so on. Here the rule which is laid down at the commencement of the preceding chapter most strictly applies, namely, *when in doubt send for the visiting surgeon.*

The death rate of herniotomies in London hospitals is high out of all proportion to the mortality which would attend these operations if only they were performed at the right time. There can be no question but that directly it is recognised that a hernia is strangulated, and that an honest attempt at reduction by taxis has not been effectual, the surgeon should perform herniotomy at once, if a final attempt at the taxis, while the patient is under an anæsthetic, should fail.

Reasons for mortality after herniotomy in hospitals.

But all who have any experience of hospital work know how grievously and unaccountably this rule is departed from, and how case after case is admitted with clear symptoms of strangulation, of four or five, or even more, days' standing, where nothing has been done, or worse than that, where the patient has been subjected alternately to castor oil or calomel and colocynth within, and to repeated and strenuous attempts at the taxis without. On inquiry it may be found that this has gone on for days until, almost every possible chance of recovery having been thrown away, the case is sent to the hospital to die, not because, but in spite of, an operation, which, if performed at the right time, would in these days almost always be successful.

Course of a typical case of strangulation.

In considering the rules which should govern the management of these cases, we will take first a typical hospital case, in which symptoms of well-marked strangulation have existed, we will suppose, for twenty-four hours, and where the hernia has not been reduced by moderate taxis without the use of an anæsthetic. It will, first of all, be important to know if the hernia be one of long standing which has suddenly become much larger, or whether this is the occasion of its first appearance, and in the former case, whether or not a truss has been habitually worn. These questions bear upon the amount of taxis which it may be safe to employ. Thus, a small hernia, down for the first time, is probably more tightly nipped and requires more tender handling than an old-standing one in which the canal is certainly dilated, and a portion, at any rate, of the gut accustomed to slip to and fro.

The house surgeon must then exercise his discretion as to whether a further trial may fairly be made of the taxis, then and there; but as a rule, unless distinct gurgling, or other indications show that the strangulation is very slight, he will be wise if he confines his manipulations to those which are necessary for the ascertaining of the condition of affairs.

He must next decide between sending for the visiting surgeon at once, or first trying the effects of a hot bath, to be, perhaps, followed up by an injection of starch and laudanum. The latter is the usual course, and in the case of old standing herniæ, where the symptoms are not very urgent, and where there seems a fair chance that the rupture will go back under taxis, after the relaxation produced by the bath and the opium, has much to recommend it. The bath should be hot (102° to 104° Fah.), and the patient should stay in it until there is a slight feeling of faintness. Taxis *may* then be tried in the bath, but it can be performed more conveniently on the bed, the patient lying between blankets. If the hernia is not yet reducible, but feels as if it "ought to go back," a further relaxation may be produced by an enema of thin starch, with the addition of about xx ♏. of laudanum. After this the attempt may be renewed, the patient lying with the head low, the foot of the bed raised, and the buttocks supported on a pillow. If the hernia be not now reduced, no time should be lost in sending for the visiting surgeon, and preparing for herniotomy.

In the case of a very acute strangulation in a rupture down for the first time, opinions are divided as to whether it be right to delay the preparations for immediate operation, even for the administration of the bath,* and bearing in mind that the anæsthetic itself will produce relaxation, and that if the rupture can be got to go back by taxis at all, the attempt will be as likely to succeed when the patient is on the operation-table, as at any other time, we believe that the safest practice is, not to wait for the bath, but to make a thorough attempt at taxis before proceeding to operate; but each case must be decided on its own merits, and sometimes the one, sometimes the other course will be the wiser.

In the cases we have hitherto considered the strangulation has not been supposed to have been of more than twenty-four hours' duration. Unfortunately, a large proportion of hospital cases of strangulated rupture are not sent in until the symptoms have been present for days. In such a case it will always be at any rate doubtful, as to whether the intestine can bear even the gentlest taxis, and it may be in a condition in which it would not be right to return it into the abdomen, even if it were possible to do so. Here every hour's delay is hurtful, and the house surgeon should immediately send for the visiting surgeon, get everything ready for herniotomy, and leave the question of making any attempt at reduction by taxis to his senior's discretion and responsibility; of the use of ice-bags, tobacco enemata, nauseants, etc., we will only say that the delay caused by their employment in a case of real strangulation is not justifiable. It may be laid down as a rule that taxis should never be tried when either fæcal vomiting or hiccough is present.

Cases of doubtful strangulation.

But all ruptures which cannot be returned, or are difficult to return, are not strangulated, even though in some cases there be a certain amount of distress and nausea. Clinical experience, not to be learned from books, will alone enable these to be distinguished with certainty, but, although some will remain doubtful until cleared up by the course of events, the house surgeon will generally be able to distinguish readily enough, whether strangulation is really present.

The cases which require most discretion are those in which at first there are no symptoms indicating that the gut is nipped beyond the fact that it cannot be returned, and then gradually the case becomes doubtfully, and at last distinctly, one of strangulation.

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* See for example (*British Medical Journal*, 1880, Vol. II., p. 864,) a paper written by my esteemed colleague, Mr. E. Owen, in which he condemns the practice altogether.

Although in such a case the visiting surgeon will very probably have some difficulty in deciding when to operate, still it is certain that he should be given the opportunity of doing so early; so that the plain duty of the house surgeon is to send for him as soon as any question of the existence of strangulation arises, and it should be remembered that in cases of umbilical herniæ of long standing, the symptoms of strangulation are frequently very indefinite.

A rupture should never be thought lightly of because it is small; on the contrary, it is the small knuckles of intestine which get most tightly nipped, especially in femoral herniæ, and, as we have said before, those which suddenly develop in consequence of some strain, are more likely to be very acutely strangulated than long-standing ones.

As to taxis.

A word or two may be said as to the performance of taxis. Whether an anæsthetic be used or no, the leg and trunk must be put into the position which will mechanically relax the margins of the apertures, and the greatest possible gentleness should be exercised. This must be specially kept in mind when the patient is under ether or chloroform, when absence of complaints does away with one safeguard. The amount of damage which may be done by rough taxis must be seen to be believed. The gut may be ruptured or bruised into gangrene, and the sac, or the more superficial tissues, may be so gravely injured that they will presently slough.

Ruptures without strangulation.

Ruptures which are difficult or impossible to reduce, but which are not strangulated, can hardly be said to be emergencies; nevertheless, we may here shortly consider them. Very often a few hours' rest in bed, in the supine position, with the buttocks slightly raised on a pillow, will enable reduction to be effected, and, in old standing cases especially, the patient should be allowed to try to put the rupture back himself if he can, for he will often succeed when the surgeon would fail.

An *ice bag* applied to the part is now a very proper remedy, except in cases of tense incarcerated ruptures, where the vitality of the tissues over the hernia is very feeble.

The warm bath, followed by a simple enema, or one containing opium as before described, is here also frequently of great service; but in the absence of disquieting symptoms, patience and rest in bed are the great agents for effecting the reduction.

A rupture is sometimes permanently irreducible in whole or part, in which case the only thing to do is to have a truss of a special shape made for its support and protection.

Acute intestinal obstructions, due to volvulus, intussusception, internal strangulation, malignant tumours, etc., involving as they do, questions of abdominal sections, or of other capital proceedings, lie outside the province of the dresser or house surgeon.

Obstruction from accumulation of fæces.

One form of intestinal obstruction however, must here be noticed which occasionally gives rise to symptoms resembling those of volvulus or intussusception, that namely which arises from accumulation of fæces. The obstruction almost always occurs in the upper part of the rectum and in the sigmoid flexure.

This condition occurs most commonly in women or in children as a sequel of some severe illness, such as typhoid fever, but examples may be found in patients of either sex, and at any age.

Usually a history will be given of habitual constipation, steadily getting more and more difficult to overcome until finally there may have been no relief by the anus for a period to be measured by weeks. In other cases some fæces may have been passed, but the bowel has never been properly unloaded. On examining the patient, it will probably be found that the intestines are greatly distended with flatus, while in the left iliac region, a soft doughy tumour is to be felt, the shape of which may be altered by manipulation, which is generally borne well, although it may be that a certain degree of inflammation of the surrounding parts has been set up. In any case distress and nausea will be present, and the symptoms may be sufficiently severe to mask the real nature of the trouble and to make it resemble a case of acute obstruction, due to some mass of new growth in the situation of the sigmoid flexure, or to an intussusception or volvulus of the bowel. A thorough digital examination of the rectum, ought never to be omitted.

The treatment in these cases consists in unloading the sigmoid flexure and rectum as speedily as possible. In the first place all the fæcal matter which can be dislodged from the rectum by the finger or a spoon, should be so removed, and masses somewhat higher up may be got at by a scoop or spoon with a longer handle. A pewter table spoon, bent so as to diminish the width of the bowl, will do. But these masses are frequently very hard, almost stony, and often they can hardly be dislodged without previous softening; while those that lie still higher up in the canal are out of reach altogether. The removal of these must be achieved by enemata injected high up into the bowel by means of a long tube.* These injections must be frequently repeated, and it may be necessary to play a stream from an enema upon the hardened collections for a long time. But although the clearing out of the canal may be very troublesome, we believe it can always be effected by the careful use of a scoop for such masses as may come within reach, and of enemata; these may be copious ones of warm water, or in more obstinate cases of warm olive oil. Again, to about a pint of the oil an ounce of turpentine may be added. The tube of a stomach pump will do in the absence of a special apparatus for the administration of these enemata.

The intestine will be left in a very atonic state for a long time after the fæces have been removed, and a recurrence of the condition must be guarded against by the frequent use of simple or astringent enemata, vegetable or saline purges, and the like. Often much good is effected by shampooing and kneading the abdomen, especially if flatus be the most prominent symptom.

Lastly, there are now a good many cases on record where the intestinal coats have been successfully stimulated through the abdominal walls by the passage of a powerful constant current, delivered through electrodes with large surfaces.

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* For the use of the long tube see chap. xxxv.

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CHAPTER XXVII.

OF EMERGENCIES CONTINUED—GENERAL EMERGENCIES, SHOCK, FITS, ETC.

We continue in this and the following chapter the consideration of the more important conditions which call for immediate relief at the hands of medical men, but especially at the hands of house surgeons, or of medical officers in charge of the casualty departments of hospitals.

In the preceding chapter we discussed those *surgical* emergencies, which had not been previously dealt with under the sections upon fracture or hæmorrhage, and there remains now the larger class of *general emergencies*, such as Collapse, the usual forms of Fits, cases of Drowning, Poisoning, etc., which although they are in no sense surgical, nevertheless must not be omitted from a work intended principally for hospital dressers and resident medical officers. But it is only with the treatment in the first instance of these various conditions, that we have here to do.

Shock or collapse.

Shock, or Collapse. For a description of this condition, and for its pathology, the reader is referred to the vivid pictures drawn by Mr. Savory,[*] or by Mr. Page,[†] or to the article by Mr. C. Moullin.[‡] We have here to consider how best to minimise its duration and severity, and we will take first, cases of *shock from severe injury without hæmorrhage.*

Shock from severe injury without hæmorrhage.

"The slow, feeble, or almost annihilated pulse, the pallor of the lips, and coldness of the extremities, the mental hebetude, the anæsthesia of the surface, the relaxation of the sphincters, the lessened secretion of the urine, the impaired muscular action,"[§] all point to a state of seeming *lifelessness*, founded on a temporary paresis (a reflex inhibition) of the circulatory system, and it is this apparent lifelessness which gives the clue to the line of treatment.

General indications for treatment.

The weakened heart can barely keep its own and the respiratory centres going, still less the cerebral cortex. The head must therefore be as low, or lower, than the rest of the body, and artificial respiration must be performed if necessary. The feeble circulation fails to maintain the heat of the body; so it must be supplied from without. There is a danger of the heart stopping altogether; therefore it must be directly or indirectly stimulated. Lastly, since in these cases of shock without hæmorrhage, it has been shown by experiment that one effective cause of the stoppage of the heart, is congestion of its right cavities and of the large thoracic veins, the surgeon should look for signs of venous distension in the neck, and if this be present the propriety of opening the right jugular vein may be considered. We have mentioned this possible treatment of shock by venæsection, for the sake of completeness of the clinical picture, and because of the high authority for its performance, but we have never seen, and can hardly imagine, a case in which the indications of congestion would justify the house surgeon in adopting this measure.

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[*] "Holmes' System," Vol. I., p. 377 (1883 edition).

[†] "Injuries of Spine and Spinal Cord," 1883, p. 145.

[‡] "International Encyclopædia of Surgery," Vol. I., p. 357. See also the Hastings Essay, 1882, on "Shock," by Mr. Furneaux Jordan, reprinted in "Surgical Enquiries."

[§] Page, *Loc. cit.*, p. 144.

Details of treatment

In practice, the first thing to do when a patient is collapsed, is to get him to bed, between the blankets, and with the head quite low. Hot-water tins, or hot bricks, should then be put in the neighbourhood of the flanks, and between the thighs, care being taken not to scorch the skin, while the patient is too insensitive to complain. The further measures will depend upon the severity of the shock. In slight cases, when the feeble pulse steadily gathers strength and the respiration continues regular and becomes gradually deeper; in fine, when it is evident that the condition is rather one of a temporary lowering of vitality than of apparent *lifelessness*, no further measures can be taken which are so useful as doing nothing will be. Rest and warmth, and lying flat, will do all that is wanted.

Cases of a higher grade of severity are those where the patient can be roused to swallow, and has a fair respiration and a perceptible pulse, but still, after a little watching, does not appear to be coming round, or may seem to be getting worse (For shock is eminently a relapsing condition.) In these cases, sal volatile, ether, alcohol, or some other diffusible stimulant should be given in small doses, frequently repeated, and of these, sal volatile is probably the best.

Most cases of shock will fall under one of these two heads, and with ordinary attention, in the absence of other complications, they will do well enough.

Extreme collapse. But more rarely, cases occur in which the collapse, the lifelessness, is much more profound, and then every exertion will be necessary to prevent the life going out altogether. In these, the respiration will be threatening to stop at every moment, or may actually have stopped, the pulse will be barely, or not at all perceptible at the wrist, the temperature may be lowered below 90°, and the insensibility profound.

Question of venæsection. In such a case (still dealing with those in which there has been no important hæmorrhage), if there be any turgidity of the veins, it is urged by Mr. Savory* that the right side of the heart will clearly be relieved by bleeding from the external jugular vein, and no one who has seen the way in which the cavities of the heart, in the lower animals, resume their functions upon the relief of distension, can doubt the physiological soundness of this advice. Nevertheless venæsection for shock is very rarely performed, and we doubt whether in practice there is often found a venous turgidity sufficiently great to strongly suggest the operation.

This may be a doubtful point, but there is no doubt at all as to the necessity of other measures. We must not wait for the natural breathing to stop, before artificial respiration is set up. The head should be placed well below the level of the legs and body; frictional warmth procured by hand rubbing; while the heart may be directly stimulated by a hot mustard plaster, or by a turpentine stupe; and the diaphragm by faradisation.†

Stimulants. As soon as the patient can swallow, stimulants should be given, but the risk of choking an insensible person must always be kept in mind. Another method of administering stimulants, however, is now coming into general favour, and is of extreme value in these cases, namely by *hypodermic injection*. **Hypodermic injections of ether, etc.** The effect of the hypodermic injection of 30 or 60 drops of ether, or of ether and brandy in equal parts, into the arm, is very striking indeed, and in many cases has undoubtedly saved life; the needle of the syringe should be pushed into the muscle, as "sub-cutaneous" injection of ether is apt to cause a troublesome slough. Stimulant enemata are sometimes very useful. Even in cases of apparently total collapse it should be kept in mind that there may be only "suspended" animation, and it is right to proceed with all approved methods of resuscitation before pronouncing the condition to be hopeless.

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* *Loc. cit.*, Vol. I. p. 383.

† For the details of the performance of artificial respiration, and the application of electricity, see under Drowning a little later. Indeed the measures for resuscitation in either case are very similar.

Reaction after shock.

Care must be exercised not to over stimulate when the effect of the collapse begins to pass off, and to leave as much as possible to *rest* and *warmth*. The collapse will in any case be followed by a reactionary period of irritation and generally of fever, and this may be much aggravated by injudicious treatment at the first. In this stage of reaction, opium, or the hypodermic injection of morphia may be administered; hyoscyamus again is often extremely useful.

Shock from hæmorrhage.

The general effects of extreme and sudden hæmorrhage are recognised as being to a large extent identical with those of true shock; nor do the two conditions differ generally in their treatment, except with regard to the great question of transfusion, which we have considered in an earlier chapter. (See pp. 56, *et seq.*)

Syncope.

Syncope. Inasmuch as faintness is due to partial cerebral anæmia, brought on by failure of the heart's action, within certain limits the treatment is the same, whether the syncope be merely emotional, or be due to some more definite cause, as general exhaustion, cold, hæmorrhage, organic disease (especially cardiac valvular incompetence), or a combination of any of these.

The common fainting fit.

As an example of the common fainting fit, we may take that form which occurs most commonly in young women or lads of feeble circulation. Such people, under conditions of bad ventilation, disagreeable sights or smells, fatigue, or of an empty stomach, are liable to attacks of simple syncope. They have a sudden feeling of nausea and giddiness, and fall unconscious to the ground. On examination there is found a marked pallor and moistness of the face, shallow but distinct respiration, a pulse just perceptible at the wrist, and a peculiar flaccidity of the limbs. The eyelids are half open and the lips parted.*

Presently, if let alone, the colour will return to the cheeks, the respiration become deeper and sighing, the eyes will open, and consciousness will return.

Of a similar nature, but even more transitory, is the purely emotional form, which occurs in perfectly healthy, strong people. Thus, grown men often faint on being vaccinated, or at the sight of blood.

Although none of these forms of syncope are dangerous, it is well that the attack should be as short as possible. The great agent in the recovery is an improvement in the cerebral circulation, and the best way to effect this is to make the brain the lowest part of the body. The patient must therefore be kept lying down (the position naturally assumed), and in every way freedom of respiration and of the circulation must be attained.

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* It may be noticed that as a general rule, men fall down in a faint as if they had been shot; women generally manage to get to a chair or to some support.

External stimuli, such as smelling salts (not too strong), the sprinkling of cold water on the head, slapping the hands, etc., must be resorted to, but stronger stimulation, as faradisation, is not required. Fainting may often be prevented if the patient be sitting at the time of the attack, by making him lean well forward, so that the head comes almost between the knees, and thus receives a good blood supply. Perhaps, too, the aorta is partly compressed by the flexion.

Extreme syncope.

But although the milder kinds of syncope are not alarming, faintness may be a condition of the greatest danger, and is indeed one of the most frequent actual causes of death. We have examples of such extreme syncope as an effect in great exhaustion from exposure, or in starvation; or it may be due to the exhaustive effect of some severe illness.*

If these cases be left to themselves, they will often insensibly drift onwards into death, and active measures must be taken to prevent this. The actual details of treatment will differ according to the particular cause in each case, but in almost all respects they are identical with those for extreme hæmorrhage, or for shock, or for drowning; namely, lying flat, warmth, stimulation, injection of ether, etc. In addition, in very severe forms of syncope it is often useful to *invert* the patient, so that the head is the lowest part of the body. This is most conveniently done by placing the legs on a couch, and the head and shoulders on the floor. (This method of resuscitation is called "Nélaton's.") Artificial respiration, faradisation, and auto-transfusion, *i.e.* emptying of the limbs of blood by hand rubbing and elevation (*vide* page 56), may all be sometimes required, but actual transfusion or venæsection is never indicated in cases of true syncope, due neither to hæmorrhage on the one hand nor to suffocation on the other.

Hysteria.

Of *Hysteria* as a *disease*, we here say nothing; for this penalty which we pay for the artificial character of our lives, appears in such protean forms, that it cannot be considered in any detail, and we will only mention what should be done in the case of a common hysterical fit.

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* Death from chloroform is usually a fatal syncope. See on this point the special chapter on anæsthetics.

General character of the fit.

Although no two of these attacks are alike, there is rarely any difficulty in the diagnosis; indeed it is only when the attack exhibits the more serious characters, of what is termed *hystero-epilepsy*, that any doubt can arise In ordinary cases the flushed tearful face, the panting breath, the emotional laughter or sobbing, the jerking movements, not truly convulsive, and the almost invariable termination in a flood of tears, and (though this is naturally not so evident) with a profuse secretion of almost colourless urine; all these points are characteristic of the hysterical attack, and could not occur in a real fit.

Diagnostic signs.

Moreover, if there be any doubt, analysis of the symptoms will show that the condition is a mimicry of graver disease, and that there is a "contrariness" in the behaviour of all these patients, which is very characteristic. Try to open the eyes, and they will be screwed up; or the mouth, and the teeth will immediately be clenched; the tongue, however, never being bitten. So, if an effort be made to sit the patient up, she will immediately flop down on the floor, but in doing so will give a further evidence of the nature of the attack, for in falling, even though there be apparently a loss of consciousness, the patient will carefully guard herself against injury.

Apparent unconsciousness is often present, and a kind of anæsthesia, so that needles may be run deeply into fleshy parts without eliciting a sign of pain; yet both these states are really deceptive. The anæsthesia is the result of an exaltation akin to the ecstasy of a flagellant, and the unconsciousness is only on the surface. In fact, as in the conditions of hypnotism (which in many other respects resembles hysteria), there is quite an abnormal intelligence of surrounding affairs. No hysterical woman, though she may be to all appearance profoundly unconscious, would ever allow anyone to cut off her hair. Moreover, while this emotional condition lasts, patients are very completely "*en rapport*" with the state of mind of those around them, and promptly become much worse, or speedily recover, according to the behaviour of the bystanders.

Hysteria not malingering.

Although we have said that the symptoms are a mimicry of other disease, no greater mistake can be made than to treat these sufferers as malingerers. The illness is real enough, although it is a moral, rather than a physical ailment; and although the symptoms be not genuine, the object to be attained is to cut the attack as short as possible, and to diminish the chances of its recurrence. On the one hand, the tendency to recur will be increased if the symptoms are treated as if they were signs of a grave mysterious illness, and on the other, the severity of the present attack will very likely be aggravated by harshness or rough treatment. The "bucket of cold water" we believe to be always harmful, but so is the other extreme of profuse sympathy, mixed with restoratives such as sal volatile, or chloric ether, or with comforting glasses of hot brandy and water.

General treatment. As we have stated before, hysterical people may be quite well trusted not to hurt themselves, so in almost all cases the best thing to do is to leave them alone. Nothing conduces more to a quick recovery than that the patient shall be convinced that her condition is one which excites no alarm, no pity, and no anger; and bearing in mind how hyper-sensitive these patients are to external conditions, all fussy friends should be rigidly excluded. Indeed, there is no necessity for anyone to remain in attendance, and if the patient be simply laid on her bed at the commencement of an attack, and left to come out of it as soon as she will, nothing better can be done.

A mixture of hysterical and alcoholic excitement is not uncommon in hospital casualty rooms. These cases again may be left to themselves or may often be more quickly restored to their right minds by a brisk emetic.* (See Drunkenness, p. 381).

Concussion. The unconsciousness which is due to a distinct injury to the head may be of the kind known as *concussion* or stunning, or it may be due to the compression of some part of the brain by a portion of the skull which has been driven in upon it; or by a collection of blood effused between the brain and its membranes, or the membranes and the bone, or within the brain substance.

With regard to the latter of these two forms, as we are considering the question of *treatment* only, we need not stop to distinguish it from that kind of comatose unconsciousness which is brought on by an attack of apoplexy, and which is presently to be described.

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* For the other forms of surgical hysteria, hysteric paralysis, neuromimesis, anorexia, etc., the reader is referred to the article by Mr. Savory in "Holmes' System," or to Sir James Paget's "Clinical Lectures."

The former condition, of concussion or stunning, appears to be a transient abolition of the higher cerebral faculties, brought on by a mechanical shaking up of the brain substance, without the infliction of structural injury. While concussion lasts the unconsciousness is absolute, while many of the symptoms of general shock are present. Vomiting very generally occurs as the condition passes of.

It is rare for the stunning to last many minutes, the reported cases of prolonged unconsciousness due to brain concussion being probably due to some definite structural brain lesion.

Treatment.

As for the treatment, the points to be recollected are almost entirely negative ones. No effort should be made to restore consciousness, but on the contrary, the shaken brain cells should be allowed the most complete repose, and darkness, silence, and such warmth in bed as may be necessary to promote recovery from the shock are indicated. After the actual concussion has passed away, it is always wise to keep the patient quiet, with a simple diet, and to avoid excitement and brain work, for the remote effects of concussion may be serious, although the immediate stunning may have lasted hardly more than a few seconds.

Fits.

Two great groups of attacks, or states of disease, are especially designated by the common term of "*fits*," although as every one knows, the name is applied to many other conditions as well. Those two are the *apoplectic*, and the *epileptic* state, and the first certainly, and probably both, may be produced by very various causes.

Causes of the apoplectic state.

As effectual causes of the apoplectic state, we may have *hæmorrhage* (the commonest), causing the attack either through brain shock, pressure, or laceration; *uræmia; acute alcoholism*, or the circulation of some other poison in the blood; or *rapid serous effusion* on the surface of the brain; (the existence of this serous apoplexy is now much questioned), and we also find cases of so called *simple* apoplexy, in which the exciting cause of the fit cannot be traced with certainty.

But the apoplectic state or *fit*, from whichever of these causes it may arise, will present very much the same symptoms; namely, "of loss of consciousness, without failure of the heart's action,"* while, in the vast majority of cases, there will be evidence also of some local cerebral lesion in the shape of convulsive movements, or paralysis, or both, the paralysis generally remaining after the actual fit has passed; inasmuch as we have only here to consider the practical management of the patient during the attack, a differential diagnosis is not at all necessary.

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* "Quain's Dictionary of Medicine" (Article on Apoplexy).

A typical apoplectic fit.

Taking the case of an apoplectic fit arising from cerebral hæmorrhage, its course will be something like the following.

Its onset.

After a varying prodromal period, during which there may have been warnings, in the way of mental confusion, giddiness, etc., the fit proper generally comes on quite suddenly, often during some emotion, or some unusual exertion. The prominent symptom is the complete loss of consciousness, but preceding this, there may be a short period of convulsive twitchings of the face or limbs. When consciousness is lost, the patient falls to the ground, the breathing becomes laboured and stertorous, with a flapping in and out of the cheeks, caused by their paralysis, and by that of the soft palate. Commonly one side of the body, and the opposite side of the face and tongue will now be found to be partly convulsed, partly paralysed. As the fit continues, the paralytic symptoms become more developed, and with this there is steadily deepening coma. Reflex is nearly or quite abolished, and the pupils may be widely dilated, or unequal, or small, but are generally fixed, and in any case, do not react to light.

Its development.

The pulse as a rule is full and slow. The larger venous trunks are often distended. (This is the condition in hæmorrhagic cases. In uræmic fits, pallor, and a small pulse are frequently present.) In such a case the coma may get steadily deeper and end in death, without any effort at a rally, in a few hours or days. If this does not happen, after a period so variable that no estimate is possible, there is a gradual lightening of the coma, twitchings cease, and reflex gradually returns. Later, the patient can be partially roused, and then returns to a state of consciousness. This, however, is rarely at first unclouded, and with it there generally comes the appreciation of permanent paralysis of the limbs or face, and often, aphasia in some one of its forms. The after history of the case is generally one of improvement.

Its decline.

General management.

Bearing in mind the usual cause of this condition of apoplexy, it will be plain that all direct attempts at rousing or restoration of consciousness will not only be futile, but will be actively harmful. The first and great point in the treatment will be to get the circulation as quiet, and the heart's action as free from embarrassment as is possible. A "do nothing" policy is therefore on many points essential; but, except in the more transient and slighter attacks, or on the other hand, in those cases of *apoplexie foudroyante*, in which death occurs almost immediately, there are certain indications for relief of the cerebral circulation which should, if possible, be fulfilled.

Relief of brain congestion. There will be little difficulty in recognising whether the case be one in which nothing is required except absolute rest and quiet watching, or whether more active treatment be called for. In the latter case, the chief measures are the local application of cold to the head, blood letting, and free purgation. If the head be hot, or the face flushed, it can never be unwise to cut the hair short, and apply an ice bag, or cold water.

Venæsection. The question of letting blood should be weighed very carefully, and at the present time it is rarely performed, still there can be no doubt that in cases where the pulse is hard, almost incompressible, and bounding, and when the veins of the head and neck are distinctly full, great relief can be thus afforded. In these cases, a small quantity of blood, rapidly extracted, will give greater relief than a larger quantity more slowly taken; so that other things being equal, venæsection of the veins of the neck or arm is the preferable mode, but four or six leeches applied to the temples will often be of great service.

Cupping and blistering. Wet cupping,* or the milder proceedings of dry cupping, or blistering, at the nape of the neck, should not be omitted as means of quickly relieving the cerebral circulation.

Purgation. The object of free purgation is akin to that of bleeding, and is similarly indicated, provided the patient can swallow.

Croton oil. The purge must be a drastic one, and very often the best is croton oil; 1 to 1½ drops of it should be rubbed up with bread and given in the form of a pill, or placed upon the back of the tongue.

Calomel. Calomel is also very generally given, in full doses, either with a purgative such as colocynth. or followed by castor oil. Other drastic purges, such as elaterium or gamboge, are sometimes used.

These various measures may rightly be employed in fitting cases, but we repeat that in the majority of cases of apoplexy, the one thing needful in the first place, is to keep the patient still in bed, with the head slightly raised, in a dark room, taking particular care that there be no obstruction to the respiration.

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* For bleeding, leeching, and cupping, see the section on Minor Surgery.

Epilepsy. The practical management of an *Epileptic Fit* may be very shortly described. In the epileptic, as in the apoplectic state, the prominent feature is the absolute loss of consciousness. The attacks also vary infinitely in their severity and duration, from those cases of *petit mal*—in which there is a momentary confusion and loss of consciousness, gone almost before it is felt—to the most violent storms of convulsions, lasting, it may be, a full half hour. The following may be taken as an account of a moderately severe epileptic fit.

A typical epileptic fit. Quite suddenly, or after some subjective premonitions, as of a creeping sensation, or travelling wave of coldness or the like, which is known by the name of an "Aura," the patient becomes unconscious and falls to the ground, often with a cry or groan. Almost all the body is then thrown into a state of tonic convulsion; the respiratory movements are arrested with the others, and the patient becomes more or less asphyxiated. The asphyxia, however, seldom becomes extreme, and after a time, shorter than it appears to the lookers on, the tonic contraction passes over into a state of general clonic convulsion, in which the limbs are tossed hither and thither, damage to them being often inflicted. At this stage, too, the tongue may be bitten, or the nails driven into the palms. **Its subsidence.** Gradually, and generally after a very few minutes, the convulsive movements quiet down, and a condition resembling coma, but which only in the most severe cases is true coma, follows. Soon this comatose state passes into one more like natural sleep; the asphyxial colour disappears, and as a rule, the patient wakes up within half an hour or an hour, ignorant of what has happened, unless previous experience has taught him to understand the position of affairs.

Management during fit. In such an attack, nothing ought to be done with the idea of any restoration to consciousness, and all that is called for, is to see that during the convulsions the patient does himself no injury, either by tossing his limbs or head about, or by getting into such a position that respiration is interfered with. Anything tight about the neck, chest, or abdomen, should be loosened, and **Care of the tongue.** especial care should be taken that the tongue does not get caught between the teeth. If this happens, the jaws must be forced open, and a piece of cork, or wood, or some other suitable wedge inserted to keep them apart.

Strenuous efforts at restraint of the convulsions appear rather to excite them, and are never necessary. As soon as the violence of the fit is over, the quieter the patient is left the better, and if natural sleep follows, it should be encouraged to last as long as possible. On waking up, if any signs of exhaustion are present, a little soup or beef tea is useful, but no alcohol.

The general treatment of the epileptic tendency, the consideration of its causation, prophylaxis, and of irregular forms of the disease, such as epileptic mania, homicidal epilepsy, etc., are outside the scope of this work.

Malingering.

Epileptic malingering. In hospital practice the house surgeon or dresser must be on his guard against being deceived by malingerers, who feign to be epileptics in order to obtain admission. The only way to detect them with certainty is to be thoroughly acquainted with the symptoms of the genuine attack.

Foaming at the mouth may be simulated by soap, and much "lather" about the lips is in itself suspicious; but the crucial point is the insensibility. In genuine cases this is absolute. Many malingerers are aware of this, and will bear pain inflicted as a test, with a fortitude worthy of a better cause, but faradisation judiciously applied can hardly be resisted for more than a few moments.

The convulsions of infants.

The Convulsions of Infants.

Several causes of.

The equal balance of the cerebral government is, in infants, very easily upset, and convulsive attacks may occur from very slight causes. Worms, teething, intestinal irritation, cerebral irritation, as in rickets, or some local irritation, even that of a pin, may, any of them, be sufficient to bring on an attack. On the other hand, the fit may be an indication of the gravest brain disease, or may stand in the place of the initial rigor which in adults heralds the onset of some acute fever.

The ordinary form.

But the "infantile convulsions" which we here consider, are epilepti-form fits, arising as a reflex from such local and temporary causes as we first mentioned, and although they are alarming, are seldom permanently harmful.

Taking as an example, the convulsions caused by the irritation of the gums during teething, we shall find that the child, after being hot and fretful for some hours previously, is noticed suddenly to "look queer," or to squint. A general spasm of rigidity then passes over the body, the face becomes pale and set, the eyeballs are turned inwards, and respiration is almost arrested, in consequence of which an asphyxial look quickly develops. This rigidity, however, generally lasts only for a few seconds, and is succeeded by twitchings of the face, and other clonic convulsions. These again quickly subside, and the child falls into a sleepy, semi-comatose condition, which soon becomes a natural sleep. Consciousness is quite abolished during the fit itself.

Vary greatly in severity. This is an account of a rather severe fit, and they are found of all degrees. Often the whole attack is compressed into a momentary loss of consciousness, with a spasm of rigidity, followed by a little drowsy heaviness. But in all, except the very slightest, the condition is certainly one which must be hurtful to brain action; the cerebral circulation, therefore, should be relieved if possible, and that quickly; such relief can be given most directly and readily by putting the child into a hot bath *at once*, at as high a temperature as can be borne (say 103° Fah.). If this can be got directly, the child may with advantage be put in clothes and all, and undressed in the water. It should be immersed up to the neck, and a sponge of cold water may be placed at the back of the head.

Indirectly, too, the bath fulfils several good purposes. The undressing of the child will enable a thorough examination to be made, and will discover if, by any carelessness, there be a pin running into the skin, or any other local irritation. Possibly the warmth may hasten the appearance of the rash of some fever, or if there be intestinal colic, this will be relieved.

The reader may be reminded of the usefulness of the small operation of lancing the gums, and it may be said that a mercurial purge will, very frequently indeed, greatly improve the condition of affairs.

CHAPTER XXVIII.

OF DROWNING, AND OF SOME OTHER FORMS OF SUFFOCATION.

Of asphyxia.

IN all forms of asphyxia it is important to recollect, first, that insensibility comes on very soon, some time before the convulsive struggles cease, and is succeeded by a paralysis of all the voluntary muscles, including those of respiration: and secondly, that the heart's action may continue for a long time after the ordinary muscular movements are abolished.

The actual cause of death is probably the hyper-distention of the right side of the heart, and it can easily be shown in animals that recovery from asphyxia is possible even after the heart has ceased to beat, if the right heart be rapidly unloaded of its blood by opening the jugular vein. In man, it is very doubtful if such recovery has ever taken place; but it certainly seems that prompt venæsection, although it is very rarely resorted to, offers in extreme cases almost the only chance. It should be remembered, too, that the performance of artificial respiration, to be directly described, in addition to re-oxygenating the blood, also relieves the distention of the right ventricle, by facilitating the passage of the blood through the capillaries of the lungs.

It will probably save needless repetition if we here consider the steps to be taken with the object of restoring suspended animation in ordinary cases of drowning; and taking this account as a typical case of suffocation, to leave it to the reader's common sense to fill in the details of the slight variations which are called for by the different circumstances of other forms.

Drowning.

In *drowning*, several causes are generally present to produce a condition of lifelessness, in addition to the asphyxia itself. Thus, *shock* is often present and may be a very important factor. *Exhaustion* from long-continued struggling, and the effects of *exposure to cold*, are also common, and have to be dealt with.

Still, the great agent in producing the condition, is suffocation, and this must first of all be combated.

Restoration from drowning.

Supposing, then, that the body of an apparently drowned person has been recovered from the water, and that respiration is found to have stopped, it may well be that the breathing can be set going again by simply making sudden forcible pressure at the pit of the stomach some three or four times, at intervals of three or four seconds; but should this not be quickly followed by respiratory movements, artificial respiration proper should be at once begun.*

For this method to be of the least avail, all its details must be carried out regularly and thoroughly; the object being so far to imitate the natural thoracic and abdominal movements, that air may be sucked into, and squeezed out of, the chest.

Artificial respiration.

The three principal ways of doing this are known as "Sylvester's," "Marshall Hall's," and "Howard's."

Sylvester's method.

In Sylvester's method (Figs. 170, 171) the arms are used as levers, acting so as to expand the chest walls by means of the muscles placed between the limbs and the trunk, the origins of the muscles acting now as insertions, and *vice versa*.

Position.

The patient should first be laid on his back, and some convenient support be placed under the shoulders, so that the chest may be thrown out, and the neck extended, with the head thrown back. (See illustrations.) If this be properly managed, there will not generally be any necessity for the tongue to be drawn out of the mouth, for the larynx will be kept open by the chin being kept well up. But it may sometimes be desirable for an assistant to draw forward the tongue, and if so, the best way to hold it, in the absence of proper forceps, is with the corner of a handkerchief between the finger and thumb. This is much better than trying to fasten the organ down to the chin with an indiarubber band, or running a hair-pin through it, as has been recommended.

Management of tongue.

Everything which in the least confines the neck, or chest, or abdomen, must be loosened, and the mouth and nostrils cleansed from any mud, etc. Should there be any water lying in the pharynx the patient may be turned over on one side to let it run out of the mouth, but no direct attempt should be made to empty the stomach.

Performance of the movements of respiration.

These preparations should only occupy a few moments. The surgeon then kneeling at the patient's head must take hold of the arms above the wrists, and carry them well over the head right back as far as they will go, as shown in figure 170. The chest-walls will then be expanded, and generally air can be heard passing through the glottis. The

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* It is generally best to do this on the spot, but if a shed or house be close at hand, the loss of a few moments may sometimes be risked, in view of other advantages.

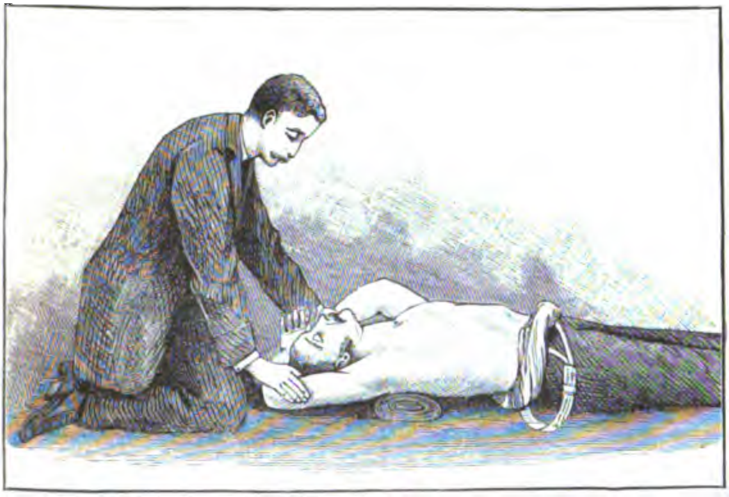

FIG. 170.—*Sylvester's Method. Inspiration.*

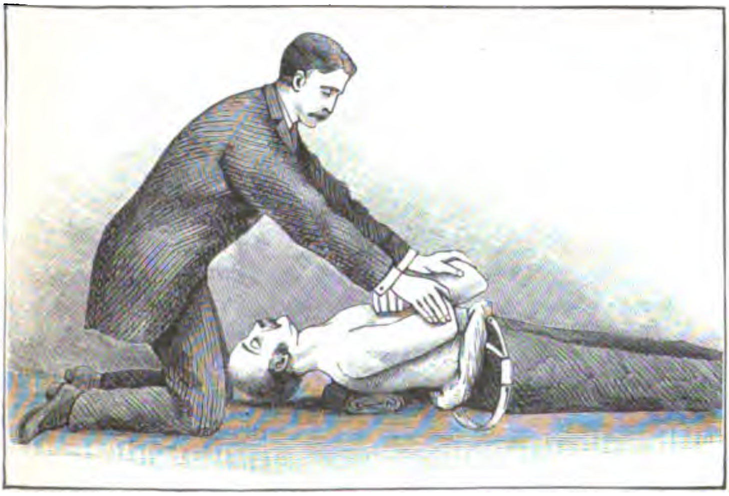

FIG. 171.—*Sylvester's Method. Expiration.*

arms must then be brought down against the sides, and the forearms crossed over the pit of the stomach. Leaning now with his weight upon them, the surgeon makes forcible pressure upon the abdomen, so as to press up the diaphragm, and this should elicit a distinct grunt from the patient; if it does not, it is doubtful if air has entered the chest cavity at all; the whole process is then repeated.

Rate of artificial respiration. The rate at which artificial respiration should be made varies with the age of the patient, and should be about the rate of normal breathing for that age, say, for an adult, 17 times a minute.

If recovery be going to take place, generally a very few minutes will be sufficient to restore natural breathing movements, and then care must be taken not to interfere with the short gasps with which natural respiration begins; but the patient must still be carefully watched, for the condition, like that of shock, is one very prone to relapse, and the respiration may fail again after it has been restored.

Minor restorative measures. While this principal restorative process is being carried out, other secondary aids to recovery should be attended to. These do not differ greatly from those already described for shock.

A warm bath should be prepared, and the dripping clothes exchanged for dry warm blankets. Frictional warmth is a very useful agent, and the extremities and flanks may be energetically rubbed in the direction of the venous circulation.

The bath, etc. As soon as respiration has been fairly established, the hot bath, if procurable, may be used. The temperature must be high, say 104° Fah., and the time of immersion short. The patient may then be put to bed between blankets, with hot water bottles, and some stimulant, such as hot brandy and water may be given, especially if there be still feebleness of the heart's action, or shivering.

Marshall Hall's method. Marshall Hall's method is generally said to be easier for one person to perform unaided if the patient be heavy, or the operator weak. Whether this be so or not, it is, we believe, certainly less efficient. For its performance, the body is rolled half over from the position of lying on the back, to that of lying on the side, when the arm which is uppermost, is pulled forwards out of the way, and pressure is made on the side of the chest to expel as much air as possible (the expiratory movement). The body is then rolled over on to the back (the inspiratory movement) and these manœuvres are repeated at the same rate as in Sylvester's method.

Howard's method. Dr. Howard's "method of direct resuscitation," is described in the "British Medical Journal," 1881, Vol. I. p. 963. Dr. Howard advocated his method very forcibly on a visit to England some few years ago. It is certainly energetic, and has proved itself to be successful, but for some reason it has not made its way to general adoption in this country.

The following are his rules of procedure:—

1. *Instantly* turn patient downwards, with a large firm roll of clothing under stomach and chest. Place one of his arms under his forehead, so as to keep his mouth off the ground. Press with all your weight two or three times, for four or five seconds each time, upon patient's back, so that the water is pressed out of lungs and stomach, and drains freely out of mouth. Then:

2. *Quickly* turn patient, face upwards, with roll of clothing under back, just below shoulder blades, and make the head hang back as low as possible. Place patient's hands above his head. Kneel with patient's hips between your knees, and fix your elbows firmly against your hips. Now—grasping lower part of patient's naked chest—squeeze his two sides together, pressing *gradually* forward with all your weight, for about three seconds, until your mouth is nearly over mouth of patient; then, with a push, *suddenly* jerk yourself back. Rest about three seconds;—then begin again, repeating these bellows-blowing movements with perfect regularity so that foul air may be pressed out, and pure air be drawn into lungs, about eight or ten times a minute, for, at least, one hour or until patient breathes naturally.

Note.—The above directions must be used on the spot, the first instant the patient is taken from the water. A moment's delay—and success may be hopeless. Prevent crowding around patient; plenty of fresh air is important. Be careful not to interrupt the first short natural breaths. If they be long apart, carefully continue between them the bellows-blowing movements as before. After breathing is regular, let patient be rubbed dry:—wrapt in warm blankets—take hot spirits and water in small occasional doses, and then be left to rest and sleep.

Dr. Howard claims a superiority for his method for the following reasons:—

1. The direct method alone provides for a thorough preliminary ejectment of fluids from the stomach and thorax.

2 This method alone makes the drainage of the pharynx constant, precluding failure from lodgements there, or suction thence into the trachea.

3. In this method, the usually impracticable task of opening the mouth and pulling forward the tongue is more than superseded by simple position.

4. The same position also secures, and in the only way possible, the instant elevation of the epiglottis.

5. The compression by this method is the most complete, and capable of the most delicate adaptations.

6. It is the only method which can be practised by one person, and which by the same person can easily be continued as long as it may be of use.

Other forms of suffocation.

In *suffocation by the fumes of charcoal or coke*, by the *carbonic acid in brewing vats*, or by the *choke damp* of mining accidents, or in cases of *hanging* other than those performed by the public executioner, we have examples of suffocation, in all of which the great agent for resuscitation must be artificial respiration. As a rule the conditions are more simple than in drowning, as shock, or exhaustion, or cold, the effects of which in drowning have to be overcome, is not generally present, but the main principles of treatment remain the same.*

We have mentioned already when considering the treatment of extreme shock and syncope, most of the other measures which are accessory to artificial respiration in cases of suspended animation, from whatever cause arising; but although *faradisation* has been alluded to on two or three occasions, and will be again in connection with recovery from some poisons, such as opium, chloral, or prussic acid, the details of the administration of the electric current have not yet been given. We take the following directions from Messrs. Beard and Rockwell's Treatise on Medical and Surgical Electricity.†

The faradic current is usually employed, but the interrupted galvanic current might answer the purpose.

Graduate the current to a strength sufficient to produce vigorous contractions of the muscles of the ball of the thumb. Then press the electrodes firmly over the phrenic nerves, between the sterno-mastoid and scalene muscles; or, put one electrode over one phrenic nerve and the other in the seventh intercostal space.

Interrupt the current about three times a minute, while the assistant presses firmly on the abdomen, pausing occasionally to observe the effect.

If no inspiratory movements appear after a number of interruptions, increase the strength of the current.

The electrodes must be large, and well moistened.

The resuscitation of stillborn infants, though carried out on the same general principles as that of the other cases of suffocation, does not come within the list of emergencies to which we have limited ourselves.

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* It will be noticed that nothing has been said about insufflation or the use of bellows to blow up the lungs as devised by Richardson, etc. We purposely omit this method, because although in skilful hands the apparatus is very useful, in the vast majority of cases the attempts to use it will only mean loss of time, during which the artificial respiration, which any person can perform, might have been begun.

† William Wood and Co., New York, 1881. See also Chap. xxx., On Anæsthetics.

Asphyxia from foreign bodies in the air or food passages.

Two forms of suffocation must be especially mentioned, those namely which are due to the lodgement of a foreign body in the commencement of the œsophagus, or somewhere in the larynx or trachea.

From a foreign body in the œsophagus.

Commonly enough a piece of hard meat is "bolted," and is arrested at the narrowest part of the œsophagus, namely, at the top. Great distress, and even dangerous symptoms of suffocation, may thus be caused. Sometimes it is possible to reach the lump with the finger, in which case, naturally, the best thing to do is to hook it up. Failing this, the next best, and the more common plan, is to push it gently onwards. Frequently, too, the lump may be moulded into a more convenient shape by pressure from the outside of the throat. So soon as the mass passes the commencement of the œsophagus, it may be trusted to go down of itself.

From fish bones, etc.

A good deal of distress is frequently caused by the sticking in the throat of a fish bone, or some other small pointed or jagged foreign body. If the body be *quite* soft and flexible, probably the best way to get rid of it is to swallow a good mouthful of bread, and to drink some water; but if there be any reason to suspect that injury to the lining mucous membrane may thus arise, it must not wilfully be pushed on, but an effort must be made to extract it.

Pins, splinters of bone, etc.

For small bodies, such as a *pin*, *small sharp splinters of bone*, and the like, the best instrument to use is a probang with bristles (Fig. 172) arranged so that they occupy little room as it is passed down, but which on its withdrawal can be expanded into a form something like a chimney-sweep's brush, in the meshes of which the object may be entangled.

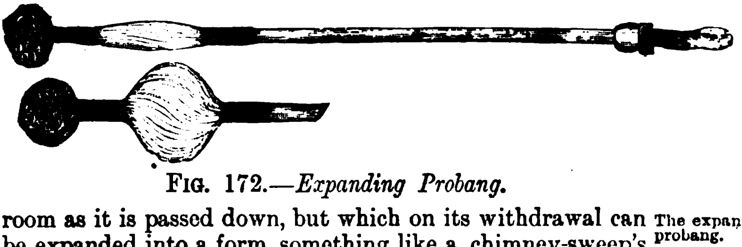

FIG. 172.—*Expanding Probang.*

The expanding probang.

But if this expedient should fail, or if the foreign body should be larger (and we may adduce as the most common examples, a set of false teeth, or coins), it would not be safe to use a probang, and patient attempts must be made to

Forceps, etc. extract it by means of forceps of especial construction, of which some examples are here given (Figs. 173, 174, 175), or by means of a coin catcher or snare. If the body can be touched at all, or its locality made out with the fingers, extraction will generally be easy enough, but if not, it may be extremely hard to lay hold of, and the greatest patience and skill will be required.

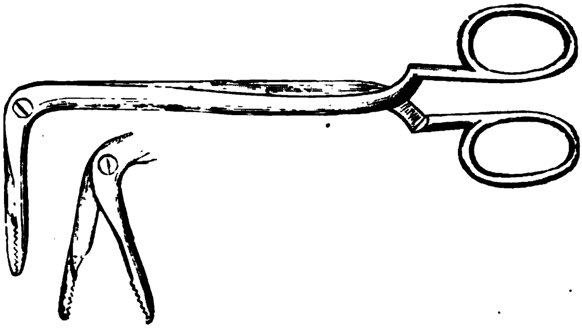

FIG. 173.—*Pharyngeal Forceps.*

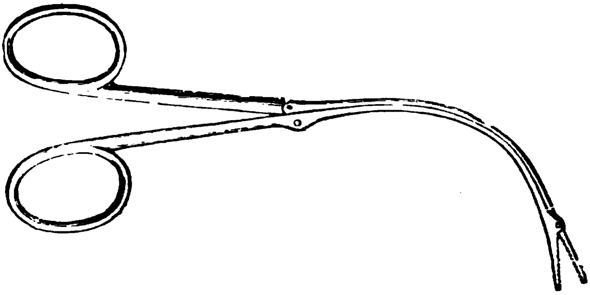

FIG. 174.—*Pharyngeal or Laryngeal Forceps.*

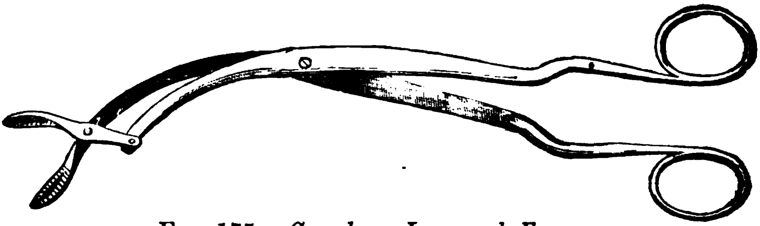

FIG. 175.—*Cross-lever Laryngeal Forceps.*

If all these attempts should fail, the question of operative measures will have to be raised, but as we do not here propose to discuss these, we have only further to express the opinion that it is bad surgery to try to produce vomiting (as has been recommended) under any circumstances, and also that the dresser or house surgeon should never on his own responsibility attempt to push onwards into the stomach a foreign body which he has failed to extract, unless that body be of such a shape and nature, as the lump of meat or soft fish bone mentioned before, that its presence there will not be hurtful.

Emesis not to be produced.

When any foreign substance (other than a poison) has once passed into the stomach, no attempt should be made to recover it by means of vomiting, nor should purgatives be given. The diet should be of a kind which will give the substance the best chance of being enveloped in pultaceous material, and the stools, of course, should be carefully watched. Under such circumstances, bodies, such as coins, marbles, etc., may be confidently expected to be passed in the course of a few days, and even such irregular bodies as plates for several false teeth, with numerous pointed hooks, have been harmlessly expelled.*

Foreign bodies in the stomach.

It sometimes, but very rarely, happens that the symptoms of suffocation due to the presence of a foreign body in the œsophagus are so urgent, that before any attempt at extraction can be made, it becomes necessary to open the windpipe and to insert some stiff tube. In this case the tracheotomy will generally have to be made rather low down, but the whole subject of the performance of this operation will be dealt with in Chap. xxxvi.

Body in œsophagus may call for tracheotomy.

Even more marked is the urgency of the symptoms of distress or of suffocation, which the presence of a foreign body in the larynx or trachea occasions. These substances are generally quite small, such as cherry stones, rice grains, small coins, etc. It never happens that they are *swallowed* into the windpipe, but they get caught in the air passages in consequence of some irregular inspiration, performed while foreign materials are in the mouth or are being swallowed. Thus one of the most distressing examples of the

Foreign bodies in the larynx or trachea.

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* It is a somewhat curious fact, that very irregular and jagged bodies often pass through the whole length of the alimentary tract, without causing any pain or trouble, until they are within an inch or two of the anus, when they are arrested and may give rise to ulceration and hæmorrhage, ischio-rectal suppuration, or other serious mischief.

accident (which we believe indeed has hitherto been invariably fatal) is the not very uncommon sucking in of the dart of the "puff and dart" toy, an inspiration being made instead of an expiration, with the result that the missile passes, head first, down to, and through the larynx, sometimes even as far as a secondary bronchus.

The consideration of the whole question of the treatment of foreign bodies in the air passages would lead us too far into general surgery. The questions which arise in such cases, indeed often call for the highest surgical discrimination and courage, nevertheless the accident is most truly an emergency, and one which a junior surgeon may be called upon to treat in the first instance, to avert impending suffocation.*

Tracheotomy *versus* removal by the mouth.

He will be called upon to decide whether a tracheotomy should be done forthwith, or whether an attempt should first be made to remove the body by the mouth, and in the majority of cases the former is the line of action which should be followed.

Attempts to excite vomiting or sneezing, patting on the back, or inversion of the body, are all attended with risk of instant suffocation, and though cases have occurred in which these measures have been successful (notably in the well-known case of Mr. Brunel) they are not to be recommended. It does happen, however, not very infrequently, that a foreign body is lodged in the larynx, and excites comparatively little irritation there. In such a case, supposing that the house surgeon is moderately skilful in the use of the laryngoscope, he may rightly attempt to remove it, *if it can be seen*, by means of laryngeal forceps, or by some kind of snare. The forceps shown in Figs. 174 or 175 may be used; or a still better pattern, the cannula lever forceps of Dr. Mackenzie (Fig. 176), or Durham's flexible forceps.

But in most cases all measures for removal will be far more safely undertaken *after* a laryngotomy or tracheotomy has been performed, and the choice of the operation will depend upon the situation of the body. If it be evidently in the laryngeal folds or pouch, then a free laryngotomy, or in children, laryngo-tracheotomy, should be the chosen operation. If it be in the trachea, or appears to be lodged in one of the main bronchi, a tracheotomy, as low down as is convenient, should be performed.

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* We consider here only genuine cases of foreign bodies actually retained in the air passages, not that large class of cases in which an irritating substance is momentarily in contact with the vocal cords and is violently expelled.

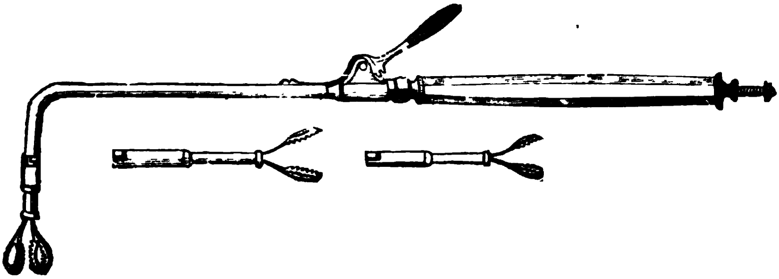

FIG. 176.—*Mackenzie's Cannula Forceps.*

Mathieu's forceps.

When the opening in the air passages has been made, its edges should be held open with a pair of ordinary retractors, or with Mathieu's three bladed forceps (Fig. 177), or, best

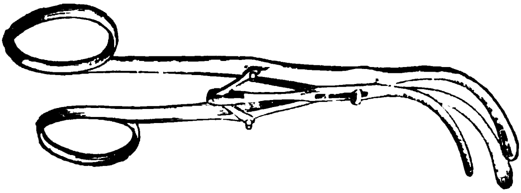

FIG. 177.—*Mathieu's Forceps. (The third blade can be removed if so desired.)*

Golding Bird's tracheal dilator.

of all, with Golding Bird's tracheal dilator (Fig. 178). In

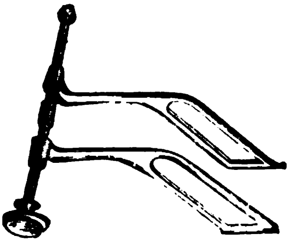

FIG. 178.—*Golding Bird's Tracheal Dilator.*

a great many cases this proceeding will be followed by the immediate expulsion of the body, either through the opening thus made, or through the larynx, the folds of which are relieved of the acuteness of their spasm; now, also, inversion, slapping of the back, etc., may be safely tried: but if, after a fair opportunity has been given for the expulsion, this does not occur, a full-sized tracheotomy tube, or the dilator before referred to, should be inserted and retained. The risk of asphyxia being now removed, the patient may safely wait for the chances of the natural expulsion of the body, which often happens, or for more deliberate exploration of the parts by the visiting surgeon, under conditions which the house surgeon has by his prompt tracheotomy made much more favourable for success.

Entry of air into a wounded vein.

We may here briefly consider the treatment of entry of air into a wounded vein in the neck or armpit.

This accident is always dangerous and often disastrous. The patient becomes pale, the pulse feeble, and the signs of dyspnœa develop. When the amount of air which is sucked in during inspiration is small, a transitory faintness may be all that is produced, but otherwise the symptoms become most urgent. For their relief it is generally advised that the vessel be at once compressed with the finger and ligatured as soon as possible, while the constitutional effects of the accident are combated by artificial respiration, compression of the main vessels, and the recumbent position.[*] Treves, however, points out[†] that artificial respiration is not called for, and urges that the first thing to do is to fill the wound with water (this prevents further ingress); then by making firm pressure on the thorax during *expiration*, he states that most of the air can generally be expelled from the veins. This effected, a ligature may be put on during expiration. Lastly, if digital pressure be employed at all, he states that the vessel should only be compressed during inspiration.

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[*] See "Erichsen's Surgery," 1884, Vol. I., p. 470.

[†] *British Medical Journal*, 1883, Vol. I., p. 1278.

CHAPTER XXIX.

OF THE TREATMENT OF CASES OF POISONING.

General considerations.

OF *Poisons.* We have now to consider the measures which should be taken when some one of the substances which are commonly used as poisons, or which may be so used, has been taken into the body in sufficient quantity to produce toxic symptoms. The following are the chief of these substances, and we will consider them in the order in which they are here given.

List of common poisons.

General Poisons.

1. Alcohol.
1A. (Ether.)
2. Kerosine oil.
3. Opium.
4. Strychnia.
5. Belladonna.
6. Prussic acid.
6A. (Nitro-benzol.)
7. Chloral.

Irritant Poisons and Caustic.

1. Carbolic, Oxalic, Sulphuric and other } Acids.
2. Corrosive sublimate.
3. Arsenic.
4. Antimony.
5. Phosphorus.
6. Caustic alkalies.

Poisonous Foods.

Shell fish. — Mushrooms.

The general poisons vary too greatly among themselves to admit of any general description, and must be considered separately.

Alcoholic poisoning.

Alcoholic poisoning may be conveniently divided into *drunkenness* and *acute alcoholism.* The former is not in itself dangerous, and usually the best course to take with drunken men or women is to leave them to sleep the effects of the alcohol off.

Drunkenness, when dangerous.

Nevertheless, even a moderate grade of drunkenness may be dangerous in old or feeble people, with degenerated tissues and weak circulation, for it may be the cause of a grave cerebral disturbance (generally of the nature of an apoplexy), or of a failure of the heart's action. The latter event must be particularly guarded against in cold weather, for, in consequence of the dilated condition of the arterioles of the skin, drunken people lose heat very quickly. Care must be taken, therefore, in thus leaving drunkards alone, that their conditions are such that there is no chance of their getting dangerously cold.

Use of emetics.

It often happens in the casualty department, that it is desirable to make a patient sober as soon as possible. For this purpose nothing is more effectual than a brisk emetic. Sulphate of zinc, sulphate of copper, or tartar emetic may be used in sufficient doses.* If the patient be violent, or refuses the draught, it may be given with the stomach pump (the use of which is described later), but in practice it will be found that if the pump has to be used at all, a sufficiently sobering effect will be produced by washing the stomach out with two or three pints of warm water. In certain cases, a hypodermic injection of one-tenth to one-eighth of a grain of apomorphia may be administered. Although this emetic is generally reserved for graver cases of poisoning *(vide infra)*, still it appears to be perfectly safe.

Faradism.

For the common occurrence of a drunken and disorderly person being brought to the hospital, and refusing to give his or her name and address, faradism, strong enough to produce painful contraction of the muscles, will generally prove effectual when the proceeding is really worth while.

Diagnosis of alcoholism.

A short experience will enable the dresser to separate ordinary cases of drunkenness from other forms of poisoning, and we need not particularise its symptoms. It is undesirable also to attempt a hard and fast differential diagnosis between the higher grades of acute alcoholism, and other grave conditions, but this is for a different reason, namely, because it is now not an alternative question, drunk? or dying? but a positive statement, drunk, *and* dying. Any patient who has swallowed enough alcohol to produce symptoms which may be confounded with apoplexy or any other severe illness, must be considered to be poisoned, and to be in need of careful treatment.

Acute alcoholic poisoning.

In these cases of acute alcoholic poisoning, the condition of the circulation and respiration will be the best guide as to whether the patient may be left to recover from his stupor without further measures beyond those which are required for keeping him warm, or whether the stomach pump should be used; but in most cases it will be best to wash the stomach out with warm water, and this should always be done if there be any sign of failure of the heart's action,

Use of stomach pump.

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* An effectual, but a very nauseous draught was, and probably still is, used at St. Bartholomew's, under the name of "half-and-half." It consisted of 30 grains of sulphate of zinc in ℥jss of water, added to an equal quantity of house physic (Hst. Sennæ Co., P.B.).

or if the breathing be suspiciously shallow. Alcohol may remain for a long time nearly unchanged in the stomach, and should therefore be removed, to prevent further absorption. In extreme cases, artificial respiration may be called for, but these are generally speedily fatal.

In acute alcoholic poisoning, as distinguished from simple drunkenness, if the stomach-pump be not at hand, emetics may be used, but as it is undesirable to further irritate the already injured stomach, preference should always be given to the pump if possible. This irritable condition of the stomach should always be kept in mind in the treatment of the case after the acute stage has passed.

Intoxication by ether.

Intoxication by drinking *ether* is hardly known in England, but is stated by Dr. Richardson to be common in some parts of Ireland. As a result of inhalation, it is of daily occurrence in all hospitals. When it is swallowed, its effects nearly resemble those of alcohol, but the period of excitement is more marked, and that of stupor less so. It is much more rapidly eliminated, so that the whole intoxication is shorter, and is less poisonous, although Dr. Morshead, of Draperstown (the head-quarters of ether drinkers), has recorded four fatal cases. Its treatment does not differ from that for alcoholic poisoning.

Poisoning by minerals.

Almost the same may be said of a form of poisoning now getting more common, namely, by *kerosine* or some mineral oil. When this is swallowed it produces flushing and excitement, followed by drowsiness. In these cases the major part of the oil is generally vomited spontaneously, but the stomach-pump should in all cases be used, or failing that, an emetic should be given.

Poisoning by opium or morphine.

Poisoning by *opium, or by its alkaloids*, is very common, and is getting more so, not from any increase of suicide by this means, but from the numerous instances of inadvertence occurring in the growing class of people who have acquired the habit of administering the drug to themselves.

When opium is taken for suicidal purposes, laudanum is generally employed, and it often happens that the suicide swallows a very large quantity. This very frequently leads to failure of the attempt, through the active vomiting which is set up.

The symptoms.

The symptoms of opium poisoning are generally distinct enough. The slow shallow respiration, and feeble fluttering pulse, the pallid, almost livid skin, covered with a cold sweat, the obstinate drowsiness or profound stupor, and above all, the fixed contracted pupils, are sufficient evidence of the condition, even without any external, or circumstantial proofs.

The treatment.

In this condition the respiratory centre is the part in greatest danger of striking work, and it must be kept going until the poison has been eliminated. By every possible means the patient must be roused, and kept awake, generally the best way is to keep him walking about supported, if necessary, on either side,* while by shouting, slapping the face or chest with a wet towel, etc., every effort must be made to prevent a relapse into torpor. The nitrite of amyl may be inhaled with advantage, and it is very important that the patient be kept warm.

If there be any reason to suspect that there may be some of the poison still remaining in the stomach, the pump should be used, or an emetic given, and after that, strong, hot coffee should be freely drunk. It is often difficult to excite emesis on account of the action of the poison upon the vomiting centre in the medulla as well as upon the stomach walls. Apomorphine acts directly upon this centre, as sulphate of zinc, or mustard and water does upon the stomach; if, therefore a brisk irritant emetic, (say 30 grains of sulphate of zinc) does not excite vomiting, it will be wise to give subcutaneously 1-10th grain of apomorphine. Any form of emetic is of course useless unless the poison has been taken by the mouth.

Value of atrophine.

If, in spite of these efforts, the stupor deepens, and the respiration further fails, the stimulus of faradisation of the diaphragm may be tried; the surgeon must be ready to adopt artificial respiration, and may consider the advisability of administering the only drug which is believed to have an antagonistic action to that of opium, namely *atropine*. Opinions as to the truth of this antagonism are very contradictory; some *e.g.*, Dr. Fothergill, holding the fact to be indisputable, while others state that its administration actually intensifies the poisoning. On the whole there seems to be sufficient evidence for the antagonism, to justify the administration of the drug in extreme cases. The most convenient form will be by the hypodermic injection of liq. atropiæ sulphatis, 4 or 5 ♏ ($\frac{1}{25}$th to $\frac{1}{20}$th grain of the alkaloid) of which might be given for a dose, to be repeated, or slightly increased, if the symptoms seem to be improving under it.

When improvement has once commenced, it is generally continuous. The pupils may remain contracted for a long time, but when the respiration and circulation appear to be well established, and the patient is able to keep himself awake, the best treatment will be warmth in bed, when natural sleep will probably soon come on and may be encouraged. The patient should be watched, however, lest the respiration should again begin to fail and other symptoms of poisoning re-develop. Alcoholic stimulants seem to be hurtful in all stages of the poisoning.

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* The Inspector at the nearest police station will usually detail relays of men for this purpose if he be asked; this will save the hospital porters much labour.

Risks of relapse.

Strychnia poisoning.—This alkaloid is a common ingredient of "vermin powders," "beetle paste," and the like, so that strychnia poisoning by misadventure is rather frequent. The symptoms of this condition can only be mistaken for those of acute tetanus, and this error can hardly be made if attention be carefully given to the case for a short time. The condition is, of course, a "tetanus" in both cases; but in that of the poisoning, the rapid development and acuteness of the attack, the universality of the convulsions, as opposed to the almost invariable spreading from the neck and jaw muscles in the ordinary tetanus, the nearly complete relaxation in the intermittent periods, and the fact that the duration of the whole attack is to be measured by hours—all these will enable a diagnosis to be made with almost absolute certainty, although indeed this is of the less importance in that the treatment may be much the same in either case.

Strychnia poisoning.

How distinguished from tetanus.

In strychnia poisoning there is a very short period of abnormal restlessness, quickly followed by a general trembling, and then complete opisthotonos, with marked "risus sardonicus," and cyanosis. In half a minute, or a minute, the spasm relaxes, and there is a period of exhaustion and respite, to be succeeded on the slightest irritation, or apparently without any cause, by a similar storm of reflex contraction. If death occurs, it will generally be from asphyxia or exhaustion, and will very often take place in less than an hour. If the dose has not been a fatal one, the spasms will gradually diminish in frequency and force. In the treatment, the main reliance must be placed upon inhalations of chloroform, and large and frequently repeated doses of chloral hydrate and bromide of potassium. Nitrite of amyl may be inhaled, "and artificial respiration if possible performed" (Murrell). If by any means the first few hours can be tided over, hopes of recovery may be fairly entertained. If the form in which the poison has been taken be rather a bulky one, as a vermin poison, then in the first instance the

Symptoms.

stomach pump must be used; or a brisk emetic, *e.g.*, one of sulphate of zinc, or of mustard and water, must be very promptly given; or ⅛th of a grain of apomorphia may be injected subcutaneously.

Belladonna poisoning.

Symptoms.

Belladonna poisoning. This is generally accidental, as from eating the berries of the "Deadly Nightshade" (atropa belladonna), swallowing lotions containing atropine, or through some similar mistake. The symptoms are very characteristic. The pupils are widely dilated, and the skin capillaries injected, producing a rash like that of scarlatina. There is much cerebral excitement, the delirium is generally chattering and restless, but may be extremely violent. The mouth is always parched, and the skin very dry.

Treatment.

Emesis must be produced by the stomach pump, or by sulphate of zinc, etc., or by apomorphine 1/10 gr., and following this, stimulants in the shape of alcohol or ether, as well as strong tea or coffee, which are also useful from the tannin they contain. Artificial respiration may be necessary in very severe cases, and in others external stimuli, such as douche, faradisation, etc.

Both morphia and chloral have an antagonistic action to atropia, but this is in neither case so distinct as that of pilocarpine, ¼ to ½ gr. of which should be injected subcutaneously, and repeated if sweating be not produced. 5 to 10 ♏ of a 1 in 20 solution of the alkaloid, or its hydrochlorate, or ʒij of the tincture of Jaborandi will be the doses required.

Retention of urine is common in these cases, calling for the use of the catheter.

Prussic acid poisoning.

Symptoms.

Prussic acid poisoning. The action of hydro-cyanic acid is so intense that death is often almost instantaneous, or there may be just time enough for a cry of agony. Even in less acute cases the symptoms come on within a few minutes. There is first respiratory difficulty, and then a period of violent convulsive movements, which are general throughout the body, but especially affect the expiratory muscles. Vomiting, and involuntary urination and defæcation, occur. This stage is followed by a period of calm, with rapidly deepening paralysis and cyanosis. This usually is quickly followed by death. In fact the whole attack resembles an acute asphyxia, or rather is one, and although treatment is rarely successful, it must be directed towards maintaining the action of the respiratory centre in every possible way.

Treatment.

Should there be time for any attempts at restoration, an emetic should be given, or the stomach pump used, if it can be employed *at once*, and then ammonia on a handkerchief, as strong as can be borne by the patient, should be inhaled, and other stimulants freely given by the mouth if they can be swallowed, if not, then brandy and ether should be given hypodermically. Stimulant enemata may also be made use of. Alternate douches of cold and hot water are powerful stimuli to respiration, and strong faradisation should always be applied if possible. Artificial respiration will most probably be called for as soon as the convulsive stage is over, and must be persevered in, although the condition may seem to be almost hopeless.

The materials used for prussic acid poisoning are usually either impure bitter almond oil, or the pharmacopœial, or "Scheele's" acid, or some one of the soluble cyanides so largely used by photographers.

Nitro-benzol.

The only substance which at all resembles it in its action is *nitro-benzol*, or artificial oil of bitter almonds, nor would the treatment of poisoning by the latter differ in any respect.

Chloral poisoning.

Chloral poisoning. As in the case of opium poisoning, this is generally a poisoning by misadventure, due to the increasing habit of self-administration of drugs by the laity. The symptoms resemble in great measure those of opium poisoning, but the fixed contraction of the pupils is absent, and the circulation is affected quite as much as is the respiration.

Treatment.

In all respects of rousing, emetics, etc., the treatment is the same as for opium, and so also with regard to effusion, faradisation and artificial respiration. It is even more important than in opium poisoning that warmth should be kept up, and the administration of a pint of hot strong coffee by the rectum will fulfil the indications of warmth and stimulation.

With regard to an antagonist, the most distinct one is strychnia; 4 ♏ of the liq. strychniæ may be injected beneath the skin, and repeated every 10 to 20 minutes if necessary.

Irritant and corrosive poisons.

The irritant and corrosive poisons may conveniently be grouped together, for the symptoms of the latter only differ from the former in their greater intensity. Moreover many of the substances in our list, in weaker solutions are irritant poisons, and corrosive poisons when concentrated. In most cases the local effects are so marked that any constitutional results of their absorption are unnoticed.

General course of symptoms in irritant poisoning.

The following is the general sequence of events after an irritant poison has been swallowed. There is first a burning metallic taste in the mouth and throat, and then a sense of intolerable pain referred to the chest, behind the sternum (heartburn). This is followed by increasing general abdominal pain, so that the legs are drawn up, as in peritonitis, and the belly becomes tumid. Vomiting is almost invariably present, and there is generally great thirst.

If the poison has been taken in a quantity insufficient to cause speedy death, and if it be *irritant* only, and not corrosive, the above are the chief symptoms. In the less severe cases these may, with appropriate treatment, be subdued; on the other hand if the dose be a fatal one, the symptoms of irritation will quickly be followed by dyspnœa and increasing collapse, so that the patient looks to be in the algid stage of cholera, and this will continue until death by syncope occurs.

In corrosive poisoning.

But if the substance be truly *corrosive* in its action, such as one of the concentrated mineral acids, the symptoms are even more severe, and run a much more acute course; it is probable that no recovery has ever taken place after such a poison has been swallowed, so that any quantity has passed into the stomach, although instances are common of great damage to the throat and œsophagus being followed by recovery; or, we should rather say, by recovery in the first instance, for generally the consequent cicatrisation has led to contraction and stricture.

Local signs in mouth and throat.

The damage to the lips and throat is the first and most prominent symptom, and gives the measure of the extent of the corrosion of the parts lower down. The corners of the mouth will be marked, and the tongue and palate covered, with a whitish coat of slough, "like a coat of paint," if sulphuric, or hydrochloric acid, or corrosive sublimate has been used; or with a yellow stain, in the case of nitric acid.

Abdominal symptoms.

In the presence of these signs of corrosion a very few minutes will decide whether the poison has been really swallowed. If so, the symptoms which have just been detailed will develop, but more rapidly and more acutely. The stage of collapse is reached more quickly, and there are signs of actual destruction of the viscera. The vomit contains shreds of sloughing mucous membrane, or it may be, casts of whole sections of the œsophagus. The abdomen becomes enormously distended with gas. The dyspnœa and dysphagia are both intense, and death usually occurs within a few hours.

Treatment.

In many respects the treatment of poisoning by irritant or corrosive substances is common to them all; and again, with regard to many, there are some particular antidotal drugs, or some especial measures to be taken or avoided,

The stomach pump, when not to be used.

In the first place, the stomach-pump should be used, unless there be evidence of such corrosion as to make it probable that the walls of the œsophagus or stomach are too much damaged for the tube to be safely passed. Such a case is indeed practically hopeless from the first, unless the damage be confined to the upper part of the canal.

The vomiting, which is almost always present, should be encouraged by giving warm water, and failing the stomach pump, the natural emesis may be encouraged by mustard and water, or by the injection of apomorphia.

As soon as the stomach has been relieved of the poison, raw egg albumen, milk, barley water, arrowroot, or whatever mucilaginous fluid can be most readily procured, should be given. Egg albumen, raw, is probably the best of all in all cases, as well as having a special action on corrosive sublimate. Salad oil may generally be given with good results, except in the case of phosphorous poisoning. The rest of the general treatment of irritant poisoning will be directed towards the symptoms of peritonitis and collapse. The pain must be subdued with full doses of opiates. The warmth of the body must be maintained, and the other signs of shock combated by such stimulation as the inhalation of ammonia, or nitrite of amyl, the subcutaneous injection of ether and brandy, stimulant enemata, faradisation of the extremities, etc. Morphia by hypodermic injection will also generally be indicated.

Special points of treatment for particular poisons. For acids.

Special points in the treatment of particular irritant and corrosive poisons.

I. *For irritant and corrosive acids.*

These comprise sulphuric, nitric, hydrochloric, oxalic, and carbolic acids ; the symptoms in the case of the first three will be similar, and in accordance with those results of swallowing any corrosive fluid which have just been described. The acuteness of the symptoms will vary directly with the strength of the solution, and inversely with the quantity of food in the stomach. In all, if a strong solution be actually swallowed, the symptoms will be of the most urgent kind, and will be rapidly fatal if not at once counteracted, so that time is of the utmost importance. The stomach pump may not safely be used unless the acid has been in quite a dilute solution. The charring in the case of nitric acid is yellow, and the vomit possesses a nitrous smell. In sulphuric and hydrochloric acids, the lips and mouth are whitish, and the vomit dark or black, containing charred shreds of mucous membrane.

The treatment lies in diluting and neutralising the acid as quickly as possible, so that all remedies should themselves be copiously diluted. Lime water (the saccharated is the best) whiting and water, chalk and water, soap and water, ordinary washing soda, or the bicarbonates of soda or potash, or any of the preparations of magnesia, in solution, are all useful alkaline remedies. Some of them will almost certainly be at hand in any given case, and it should always be borne in mind that "the nearest remedy is the best" (Murrell).

In addition to alkalies, milk, olive oil, and the other demulcents mentioned above are all useful.

Oxalic acid and salts of sorrel.

In poisoning by *Oxalic acid* or by *Salts of sorrel* (the acid oxalate of potash) the main special point to bear in mind is that the alkaline oxalates are soluble and poisonous, so that chalk, whiting, lime water, or magnesia must be used to neutralise the acid, and not soda, potash, or ammonia, or the carbonates of any of these. Oxalic acid poisoning is rather common and is frequently suicidal. The symptoms are those already detailed, save that collapse is often disproportionately marked, and that death may be very speedy.

Carbolic acid.

Carbolic acid poisoning is now perhaps the commonest of all forms of poisoning by misadventure, and is also used for the purposes of suicide. Its corrosive action is, in concentrated solutions, very conspicuous, but the destruction does not extend deeply into the tissues. The mouth and jaws are usually covered with a white, leathery pellicle. The symptoms are those of poisoning by any corrosive fluids, but pain is even more intense than in the case of the other acids, while on the other hand the collapse, and other symptoms of the gravest local injury are not so manifest, nor, is the whole course of events after the poison has been taken, so hurried.

Treatment.

Treatment. The sulphates of magnesia, or soda, in half ounce doses in a tumblerful of warm water should be given at once and the stomach washed out with warm water, or with the same alkaline solution three or four times, half a pint or so of the solution being afterwards left in the stomach. In the absence of the stomach pump, vomiting must be produced by zinc sulphate, mustard and water, ipecacuanha, or the injection of apomorphia. Later on demulcents, such as barley water, olive oil, etc., may be given, or an ounce of castor oil.

Shock is often very marked and must be treated by frictional warmth, ammonia, etc., as before stated. If there be much restlessness *chloral* should be given, as there is an antagonism between it and carbolic acid.

The urine is often dark and scanty, and may be suppressed in acute carbolic acid poisoning. The carboluria is then a grave symptom, but it often happens in surgical cases, that carbolic acid, not necessarily used in very large quantities, is absorbed and produces a similar inky urine.

For the acid salts of mercury.

II. For *corrosive sublimate* (perchloride of mercury), the acid nitrate of mercury, etc., albumen in any shape (even gluten of flour is better than none, but white of egg is best) should be freely given, as an insoluble albuminate is thus formed. Emesis should be encouraged by warm water or mustard and water, if vomiting be not active without such aid. If the solution has been concentrated, the stomach pump must only be used with great care.

Arsenical poisoning.

III. *Arsenical poisoning* is generally effected by arsenious acid (white arsenic), and is frequently given with criminal intent. The symptoms do not come on immediately after taking the poison. The vomiting and purging resemble at first an intensely violent bilious attack; afterwards the symptoms are more like acute cholera, and the diagnosis is often obscure. The emesis must be encouraged, and the stomach emptied by the pump. This should be followed up with oil, switched eggs, or a mixture of oil and saccharated lime water. Magnesia is also very useful, but the substance which best neutralises the action of arsenic or arsenious acid in solution, is the freshly prepared hydrated peroxide of iron. This can be quickly made by adding half-an-ounce of common carbonate of soda to a fluid ounce of tinct. or liq. ferri perchlor., and filtering. As a substitute, dialysed iron in ounce doses, may be given.

If the diagnosis of the acute form of this poisoning is not generally easy, that of chronic arsenical poisoning is always difficult, but this condition does not fall under the heading of emergencies.

For Antimony.

IV. *Poisoning with antimony*, in the form of tartar emetic.

The symptoms come on soon, and generally the vomiting is so violent that the whole of the poison is soon ejected. If not, the symptoms resemble those of arsenical poisoning, but there is more depression. The treatment is the same as in arsenical poisoning; but in addition, *tannin* should be given in the form of very strong tea or coffee, or by means of preparations of oak or cinchona bark, or of tannic acid itself.

Phosphorous poisoning.

V. *Poisoning with phosphorus.* This is usually taken in the form of beetle paste, or rat paste, or sometimes by swallowing the heads of lucifer matches. In these cases the symptoms declare themselves quickly after the poison has been taken, and are generally prolonged over days, or it may be weeks. The prominent symptoms are great thirst, with heartburn, and violent vomiting, the vomit being phosphorescent in the dark, and the breath smelling strongly of the poison.

Acute and sub-acute poisoning.

Oil not to be given.

The result will mainly depend on whether the vomiting be sufficiently active to prevent an absorption of a really poisonous amount. If the quantity absorbed be large, the symptoms remain acute; hæmatemesis and bloody purging are often present, with cramps, and finally coma. But if only a small, but still poisonous quantity has been taken (say ½ to 1 gr.), after the first indications of irritation have passed over, the symptoms usually subside for a day or two, and then the signs of acute atrophy of the liver begin to declare themselves. Then the jaundice deepens, and a comatose, typhoid condition, with delirium, generally ends in death in a few days, although in some of the milder cases recovery may take place. The early treatment of the poisoning does not differ from that of other irritants, save that oil, in which phosphorus is soluble, should never be employed with the idea of soothing the intestinal mucous membrane. After the stomach has been emptied of its contents either naturally or with the stomach pump, mucilage, magnesia in barley water, or similar demulcent fluids may be given. The only drug which seems to have any action in preventing the liver changes, is the French oil of turpentine in full repeated doses of 15 ♏ to ℥ss.

Chronic poisoning.

Chronic phosphorous poisoning, phosphorous necrosis, etc., cannot here be discussed, as they do not occur as emergencies.

Poisoning by caustic alkalies and their carbonates.

VI. *Poisoning by caustic alkalies and their carbonates.* This form of poisoning is rare, but potash or soda lye is sometimes taken. The symptoms are those of ordinary irritant poisoning, except that violent purging is generally a prominent symptom. In the treatment, the question of the use of the stomach-pump must be decided by the amount of caustic destruction. Weak acids, such as vinegar and water, or any of the dilute pharmacopœial acids, should always be given.

Poisonous foods.

Shell fish.

Poisonous foods. A form of acute gastro-intestinal irritation, often so severe as to justify the term poisoning, is not infrequent as a result of eating shell fish, especially mussels.

In the treatment, an emetic should be given in the first place, and afterwards a full dose of castor-oil with 20 to 30 ♏ of laudanum, chlorodyne, or of some similar sedative.

This is to be repeated if necessary. Atropia is here also indicated, although not so distinctly as in the case of poisoning by muscarin. The manner of administering, and the dose, are the same as in the following case.

Mushrooms.

Muscarin poisoning.

Mushroom poisoning should not go without mention, although in London cases are rare. Most fungi, edible or inedible, may produce, if improperly cooked, symptoms of a mild degree of irritant poisoning, similar to those which have been mentioned, and which may be treated in a similar way. But cases of true *muscarin* poisoning exhibit a much higher grade of toxic symptoms. The fungi which contain muscarin or some similar alkaloid are not very numerous in England, the principal one being the fly fungus (amanita muscaria). When the more actively poisonous fungi have been eaten, as a rule great cerebral excitement is caused, in addition to the more strictly irritative effects on the alimentary tract.

Antagonism with atropia.

In the antagonism between *muscarin* and *atropia* we have perhaps the best example of this mode of the physiological action of drugs. Digitalis also, though in a less degree, is antagonistic to muscarin. Whenever, therefore, the symptoms of mushroom poisoning are grave, and especially if there be delirium or mania, atropia should be given, say iij to v ♏ of the liq. atropiæ, by the mouth, or ij ♏ subcutaneously, or as an alternative treatment, full doses of the tincture or infusion of digitalis may be administered. In other respects the treatment should consist in removing the poison from the alimentary tract as soon as possible, by means of emetics, etc., and in allaying the irritation by demulcents.*

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* For further information as to the treatment of cases of poisoning, the reader is referred to Dr. Murrell's excellent little pocket book ("What to do in cases of Poisoning," H. K. Lewis, 1884), to which also the Author is much indebted.

SECTION VII.

OF THE ADMINISTRATION OF ANÆSTHETICS.

By JOSEPH MILLS.

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CHAPTER XXX.

General considerations as to value of anæsthetics.

ANÆSTHETICS are administered to patients to prevent their feeling pain during surgical operations; for the diminution of pain in labour; to produce relaxation of muscles, as in reducing dislocations or in setting fractured bones.

They are also given to assist the medical man in making a diagnosis, as in obscure abdominal tumours, examinations of diseased joints, or in the detection of malingering.

Though it is a great thing to be able to say that patients can in a few minutes be placed in such a profound sleep that they are quite insensitive to pain, and are unconscious, this is not all that can be said in favour of anæsthetics. By their means a patient may be brought to a state of perfect stillness, so that many operations which could not be done before the days of anæsthesia, because of the patient's struggles, are now performed with comparative ease.

Again, as the patient does not feel pain, more time can be spent in the performance of the operation, in ligaturing all the smaller vessels and in many of the minor details on which to a great extent its success depends. As there is less difficulty in persuading patients to undergo operations, many more are now performed. To the surgeon, also, it is a great comfort that he can do what is necessary for his patient without giving pain, and without the struggles and screams which were formerly witnessed.

The frequent use of anæsthetics in medical and surgical practice renders their administration one of the most important subjects for investigation. In the hands of those well acquainted with their use they are capable of bringing the greatest relief to sufferers, and of facilitating the work of the medical man; but if used carelessly or with insufficient knowledge of their action, their administration is accompanied not only by additional anxiety and annoyance to the surgeon, but by the greatest danger to the patient.

It is not to be supposed that there is no danger at all when anæsthetics are used by those who are experienced in their employment, for sensibility and life are so closely allied, that a patient cannot be deprived of the one without there being of necessity some risk to the other, but there is no doubt the danger is least when they are given judiciously and by one accustomed to their administration.

As any medical man may be called upon at any time to give an anæsthetic, it is highly important that every one should make himself thoroughly acquainted with the best and safest means of administering one, or more, of those commonly in use, so that in any emergency he may be able to produce and maintain anæsthesia, leaving the operator free from all care and anxiety except that which the operation itself entails.

Not only must the administrator depend entirely on his own judgment, but he must give to the administration the whole of his attention, and must not interest himself in, or in any way assist at, the operation.

It is quite possible for the operator to superintend the administration of the anæsthetic, or for the administrator to assist in the operation, provided all be going well, both with the operation and the administration, but in the critical part of the operation, in vain does the nervous administrator look for the guidance of the operator, who is compelled at this period to devote himself entirely to his own work; so, on the other hand, when any difficulty occurs with the anæsthetic, the administrator cannot lend a hand to the operator, and as difficulties in the operation are not uncommonly almost simultaneous with alarming symptoms to the patient (for example, a sudden gush of blood, accompanied by syncope), the operator and the administrator must each be thoroughly competent to take the entire control of his own department.

History of anæsthesia.

Those who are interested in the history of anæsthesia, should read Snow on "Anæsthetics," the works of Sir J. Simpson, Vol. II., and a very interesting account of the modern history, written by Sir James Paget in "The Nineteenth Century," for December, 1879, entitled "Escape from Pain, the History of a Discovery."

In 1799, Sir Humphrey Davy produced anæsthesia by himself inhaling nitrous oxide gas, and he recommended its use in surgery.

In 1844, Horace Wells, a dentist of Hartford, inhaled the nitrous oxide gas himself, successfully gave it to fourteen or fifteen patients, and then went to exhibit its effects at Boston for extraction of a tooth. "Unfortunately for the experiments," writes Wells, "the bag was withdrawn too soon, and the patient was but partially under its influence when the tooth was extracted. He testified that he experienced some pain, but not as much as usually attends the operation." After witnessing this solitary experiment the audience pronounced it a humbug affair and an imposition. Wells was hissed away, and for a time gave up the profession in disgust.

In 1846, Morton, a former pupil of Wells, who was present when he failed to produce complete anæsthesia with the gas, applied to him for particulars concerning its manufacture; for this purpose he was referred to Jackson, a chemist, who advised him that sulphuric ether was more easily obtained, and had much the same effect.

Morton proved the efficiency of ether on Eben Frost, for the extraction of a tooth, and then gave it at the Massachusetts hospital to a patient from whom Dr. Warren removed a tumour of the neck, on 16th October, 1846; this then is really the date of the commencement of the practice of producing anæsthesia for surgical operations.

On this side of the Atlantic it was first given by Mr. Robinson to Miss Lonsdale, in the surgery of Dr. Boot, of Gower Street, for the extraction of a tooth on the 19th of December, 1846. Two days later it was given to two of Mr. Liston's patients at University College Hospital for amputation of the thigh, and for avulsion of the toe nail—and it then came into very general use until the November following, when Sir James Simpson discovered the properties of chloroform, which for a time almost entirely superseded ether.

Though Sir J. Simpson was the first to use pure chloroform, it had previously been used in the form of "Chloric Ether" (a mixture of chloroform and alcohol) at St. Bartholomew's Hospital, by Sir William Lawrence and Mr. Holmes Coote.

Fit subjects for anæsthesia.

The popular notion that anæsthetics, especially chloroform, are inadmissible in cases of heart disease, is erroneous. The only affection of the heart which contra-indicates their use is fatty degeneration, which is extremely difficult to diagnose. And if it be necessary for a patient with fatty disease to undergo an operation he would be as likely to die of the shock of the operation without an anæsthetic as from the anæsthetic, cautiously and properly administered. Patients with slight valvular disease, who are otherwise healthy, take anæsthetics very well. Drunkards and those who habitually indulge in alcohol take them badly.

Preparation of patients.

It is impossible to lay too much stress on the importance of having a patient properly prepared before an anæsthetic is given; this is of course out of the question in cases of accident or emergency, but, in the majority of cases, is easy enough. Care should be taken that the bowels are acting properly, and if necessary, a purgative should be given a day or two beforehand. No food should be taken for four or five hours before the time appointed for the operation. When this is fixed for the early morning, unless the patient be very weak, it is best to give nothing after awakening. When the patient is in such a state as to require constant feeding, a little beef tea with some brandy or champagne may be given three hours before the operation. It is very important that the stomach should be empty at the time an anæsthetic is taken, not only on account of the danger to the patient of being choked by some undigested portion of food being vomited into the pharynx, and at the next inspiration drawn into the larynx or trachea, and so producing asphyxia; but also on account of the faintness, which is so commonly seen both before and after the vomiting. This syncope is generally most marked before the vomiting, after which it frequently passes off, though it may continue for some hours.

Vomiting is almost sure to occur if the stomach contains food, and it may, and does sometimes happen when proper preparation has been made. In the former case the vomiting lasts much longer, and is accompanied by much greater syncope than in the latter; moreover, patients with loaded stomachs always take an anæsthetic abnormally; this is most noticeable in children. They are generally a longer time going under the influence, and require a larger quantity of the anæsthetic, and when under, they may, although apparently deeply narcotised, start and cry out at the commencement or at any time during the operation, or they may remain in a state of such deep narcotism that it is impossible to rouse them for perhaps half an hour, during the whole of which time they are in a dangerous state from syncope.

Choice of anæsthetic.

And now with regard to the choice of an anæsthetic. Those most commonly in use are nitrous oxide gas, chloroform, ether, and bichloride of methylene.

Nitrous oxide is suitable for very short operations only, so that for ordinary surgical cases the choice rests between ether and chloroform, or bichloride of methylene, the last two being similar in action, though some consider less sickness is caused by the methylene.

Chloroform *versus* ether.

Sir James Simpson says, "As an inhaled anæsthetic agent, chloroform possesses over sulphuric ether the following advantages:—

"1. A much less quantity of chloroform than ether is requisite to produce the anæsthetic effect.

"2. Its action is much more rapid and complete, and generally more persistent.

"3. The inhalation and influence of chloroform are far more agreeable and pleasant than that of ether.

"4. Considering the small quantity requisite, as compared with ether, the use of chloroform is less expensive.

"5. Its perfume is not unpleasant, but the reverse; and the odour of it does not remain for any length of time obstinately attached to the clothes of the attendant, or exhaling in a disagreeable form from the lungs of the patient, as so frequently happens with ether.

"6. Being required in a much less quantity, it is much more portable and transmissible than ether.

"7. No special kind of inhaler or instrument is necessary for its exhibition."

With the exception of "2, its action is much more rapid and complete" (improvements in ether inhalers having now rendered the action of ether more rapid and quite as complete as chloroform), all the advantages which Simpson claimed for chloroform over ether must be allowed to hold good.

Chloroform has even yet another advantage over ether which might have been claimed for it, which is that it does not so greatly irritate the air passages.

But ether possesses over chloroform one advantage so great as to more than turn the balance in its favour.

Effects of ether on heart's action.

For whereas ether stimulates, chloroform is apt to depress, the heart's action. During the administration of chloroform there is sometimes very alarming syncope, which rarely occurs with ether.

From experiments on animals it appears that the heart may be paralysed by chloroform, but not by ether.

Then again the vomiting which frequently accompanies the administration of an anæsthetic, as a rule lasts longer after chloroform than after ether.

Ether then seems to be the safer, and so should be used in all suitable cases.

Chloroform, when to be preferred to ether.

The following are the cases in which ether is not recommended:—

1. Children.
2. Old people.
3. Midwifery.
4. Operations on mouth or nose.
5. Operations on the eye.
6. Ligature of large arteries.
7. Setting of fractures.
8. Obstructed respiration.
9. Bronchitis.
10. Emphysema.
11. Empyema.
12. Phthisis.
13. Laryngitis.
14. Patients under opium.
15. Advanced kidney disease.

(1.) Children under ten or twelve years take chloroform very well; but are readily asphyxiated by ether, and are frightened by the apparatus.

(2.) People over sixty or sixty-five years take chloroform well, with little, if any, struggling, but are greatly irritated by ether, especially if, as is frequently the case, there is a tendency to bronchitis.

(3.) As the first stages of the inhalation of ether are far more unpleasant than those of chloroform, and as the first stages only are requisite during the pains of labour, chloroform, which is exceedingly well borne in these cases, is preferable.

(4.) As the influence of chloroform lasts longer than that of ether it is preferable for operations on the mouth and nose. In these cases chloroform possesses other advantages over ether, in that it may readily be given on a piece of lint, or, better still, through a tube inserted into the mouth or nostril without obstructing the operator; moreover, its administration is not so likely to be accompanied by coughing, nor does it occasion such a flow of viscid saliva. These, in operations such as that for cleft palate, are important considerations, for the operator requires the parts to be as still as possible, and it is necessary for him to get a good view without having to be perpetually sponging out saliva from the fauces.

(5.) In operations on the eye, chloroform may be given on lint, without obstructing the light or impeding the operator's hands, as sometimes happens with an ether inhaler; and as its inhalation does not occasion so much congestion and hæmorrhage, it is generally preferred to ether in ophthalmic surgery.

(6.) For the ligature of large arteries, such as the subclavian, chloroform is preferable, because the veins are so distended during the administration of ether as to render the operation more difficult and more dangerous.

(7.) In cases of fracture, which require an anæsthetic whilst the parts are being placed in apposition during the time the muscles are relaxed, chloroform is preferable, because patients recover from its effects quietly, the inhalation of ether being sometimes followed by a state of delirium and struggling which would be likely to *displace* the fractured ends of the bone and necessitate their re-adjustment.

(8 to 15.) Patients who are suffering from any obstruction to the respiration, whether the obstruction be in the lungs or in the air passages, from pressure of tumour or abscess on the neck, or from pressure on the diaphragm from rapid distension of the abdomen (as in cases of intestinal obstruction, hernia, etc.), and patients under the influence of opium; not only take ether badly, but its inhalation is likely to be followed in some of these cases by bronchitis or hæmoptysis, in others, by a dusky, drowsy, state, in which the patient may gradually die.

Administration of chloroform.

Supposing now that chloroform has been chosen as the most suitable anæsthetic, the following are the general directions for its safe inhalation.

A third person should be present.

Artificial teeth should be removed before any anæsthetic is administered; cases have occurred in which, by becoming detached they have fallen into the pharynx.

It is advisable that no anæsthetic should be given except in the presence of a third person, because assistance may be required either in restraining any struggling which may occur, or in restoring animation. Moreover, owing to the extraordinary dreams which sometimes occur during anæsthesia, women have occasionally been induced to bring serious accusations against medical men, which might easily have been disproved had a witness been present.

The pure chloroform only should be used; Duncan and Flockhart have the reputation of being the best makers.

No inhaler is necessary.

All that is required is to cut a piece of lint about 12-in. by 6-in., and fold it so as to form a square of 6-in.

A chloroform drop bottle which holds one ounce is the most convenient size—a stock bottle containing two or three ounces of chloroform being at hand, if required.

The method of inhalation.

The patient should be in the recumbent position, and should have none but light garments on, and these must be loose about the neck and abdomen. It is better for the patient to lie on the back while anæsthesia is being produced, even if during the operation he be required to be on the side; because in the former position the administrator has more control over him; for example, when lying on the side patients sometimes bury the face in the pillow so as to prevent a continuance of the administration. The head should not be much raised; as a rule one pillow is better than two; if two are used, the lower one should be placed partly under the shoulders, so as to make a gradual incline, and to prevent the head being tilted forward and thus obstructing the respiration. It is well to commence by sprinkling about five drops of chloroform on the lint, which should be held about two inches from the patient's face, just to allow him to become accustomed to the vapour. In a few seconds, without removal of the lint, a little more chloroform may be added, and the lint turned so that the wet side may be towards the face. When more chloroform is added, the lint should be held two inches from the face, but as the chloroform evaporates it may be gradually approximated, so that at the time when it is necessary to add more chloroform the lint rests on the face; when more chloroform has been added, the lint should be turned and the administration continued as before, the quantity of chloroform sprinkled being slightly increased each time. Care should be taken that the part of the lint which is wet with chloroform be not allowed to touch the face, as it is apt to blister.

Inhalers.

Of the many different kinds of chloroform inhaler, that invented by Clover is the most ingenious and the best, being so constructed as to insure a mixture of 3 to 4 per cent. of chloroform to air, which is said to be the safest proportion. Junker's is also a very useful apparatus see p. 416), but the advantages of the lint are cleanliness, simplicity, and the regularity with which the vapour can be supplied.

Restraint of patient, etc.

At first it is unadvisable for the patient to be held, but when the chloroform begins to take effect and produces excitement, it is necessary for him to be restrained sufficiently to allow the administration to be continued and to prevent his doing any damage with his arms or legs, but it is not necessary, as a rule, to keep him absolutely still; indeed it is unadvisable, for in most cases the greater the resistance offered to the patient the greater the amount of struggling.

Adults struggle most, and men more than women, and the subjects of delirium tremens and drunkards always give great trouble during this stage; but in any case the struggling is least when the administration is regular and gradual.

When an unusual amount of excitement occurs the chloroform should be continued unless the respiration be impeded, in which case it should be discontinued for a few inspirations. If a sufficient quantity of chloroform be not given during this stage, either the struggling will be unnecessarily prolonged, or some recovery from the effects having taken place, perhaps two or three of these stages will be induced in the one administration. Whilst struggling, the respiration is often very deep; a full inspiration occurs and there is a long pause before expiration. Care must therefore be taken that the vapour is not given too strong, because as the lungs remain so long filled with the vapour a good deal is absorbed.

The muscular excitement generally subsides gradually, and the patient passes into a state of slumber with more or less snoring and relaxation of the muscles.

It is well to stop the administration for a few seconds as soon as the patient is under the influence, especially when there has been much struggling, because of the cumulative property of chloroform. Its effects often become more intense after its administration has been stopped. This is no doubt due to a portion remaining in the lungs and being afterwards absorbed.

Patient when ready for operation.

A patient is generally said to be ready for the operation to be commenced, when touching the inner border of the eyelid or ocular conjunctiva with the finger produces no reflex action. In some cases it is necessary that touching the cornea, which is far more sensitive than the sclerotic conjunctiva, should produce no reflex action.

But the eye is by no means a certain test, as its sensibility varies so much in different people, and the patient cannot usually be said to be "ready" unless, in addition to the loss of reflex action of the conjunctiva, there be also general relaxation and more or less snoring. Constantly touching the eye should be avoided while the patient is being got under, for this will to a great extent deprive it of its sensibility, and so lead the administrator to imagine the patient to be more thoroughly narcotised than is really the case. After one eye has been touched several times it is well to try the effect of touching the other. Again, when the patient is under the influence, the chloroform should be frequently applied in small quantities, rather than in larger amounts administered only upon the reappearance of reflex action.

If at the commencement of the operation, reflex is found to be still present, the first incision will cause not only movements of the limb which is being operated upon, but such deep inspirations that a small quantity of chloroform is sufficient to very soon produce a more profound anæsthesia, and a larger dose is both unnecessary and dangerous.

Condition of the eye.

During the struggling stage the conjunctiva often becomes slightly congested, assuming again its normal appearance as the excitement passes off.

In this stage also the pupil is sometimes dilated, but when fully under the influence the pupil is slightly contracted and acts with the light. In very deep narcosis only, such as is sometimes necessary in operations on the more sensitive parts, as the eye, genitals, or anus, does it fail to act with the light.

Dilatation of the pupil occurring during thorough narcosis should be regarded as a signal of danger, and the administration must be stopped. It may be a premonitory symptom of vomiting, or it may be caused by asphyxia, or because the patient is too fully under the influence.

When there is much struggling the face generally becomes congested, and sometimes slightly livid.

Lividity or pallor may occur at any time during the narcosis, the former being caused by obstruction to the respiration, the latter being a symptom of syncope.

Either of these changes in the face is to be regarded as a signal of danger, and the administration should be stopped.

The pulse.

The pulse must be carefully watched from the beginning to the end of the administration, for though it is possible that in some cases the pulse and respiration simultaneously cease, there is no doubt that very often the first warning of approaching danger is given by the pulse, which, before stopping, gradually becomes weaker ; it may be irregular or intermittent for many seconds before any alteration is observable in the respiration.

Immediately on the occurrence of any such change in the pulse, the administration must be stopped, and preparation must be made for the application of restorative means.

When for the convenience of the operator the patient is lying upon one side, the radial pulse of that side should not be felt, as the weight of the body on the brachial artery is apt to impede or stop the circulation, and give rise to unnecessary alarm.

The respiration. The respiration, too, is to be carefully watched from the commencement to the end of the administration. It is not sufficient simply to watch the movements of the chest walls and abdomen, but it is necessary also to listen to the breathing, especially when there is any doubt as to the efficiency of respiration, as the chest walls and abdomen will sometimes go on moving though no air be entering the lungs. Obstruction to the breathing may take place in the bronchi, trachea, or larynx, from blood, or vomit. It is most frequent in the pharynx, and is generally caused by the falling back of the tongue, or the approximation of the glottis to the back of the pharynx; this is due to a faulty position of the head, generally by the head being tilted forward and the chin being too near the sternum; sometimes, though rarely, by the head being thrown too far back. It may generally be remedied by a change in the position of the head, by drawing the chin forcibly from the sternum, or turning the face to one side to prevent the tongue falling back. If the obstruction be not at once removed by these means, there should be no delay in seizing the tongue with a pair of dressing forceps and dragging it out of the mouth, though such severe treatment is very seldom necessary.

Some patients are not able to breathe freely through the nostrils. In these cases, when under an anæsthetic, it sometimes happens that at each attempt at inspiration the lips are tightly pursed up, or flap together like a valve, entirely preventing the entrance of air. This is very easily remedied by separating the lips, but may cause needless alarm, or even asphyxia, if it be not corrected.

Infants, after the completion of the operation for hare-lip, very often are unable to breathe properly unless the lower lip be drawn down with the finger; they therefore require careful watching during the recovery from chloroform.

If alarming symptoms commence with the respiration there is less likelihood of their terminating fatally, provided they are observed immediately on their occurrence, because the respiration may be supplied artificially.

Syncope. The greatest danger which attends the administration of chloroform is *syncope*.

This may be produced by giving too large a percentage of chloroform to air, or by an over-dose, or by shock from the operation. This shock is very marked when, in the operation for strabismus, the internal rectus is divided, the pulse often intermitting and remaining feeble for some minutes. It is said also that the pulse intermits at the moment the cord is divided in the operation of castration. Syncope may also be caused by the loss of blood during an operation, or it may accompany vomiting. When the face becomes pale and bedewed with a cold sweat, the pulse weak, slow, or irregular, and the respiration slow and shallow, no matter what the cause of these symptoms may be, the chloroform must be immediately stopped, and the administrator must be prepared to apply restorative means.

Sudden stoppage of the circulation and respiration have been said to occur simultaneously under chloroform without the slightest warning, but there is no doubt that before stopping, the pulse generally becomes more and more feeble, and then imperceptible; the respirations for a few seconds continue, and then becoming more and more shallow, cease also.

Restoration in extreme syncope.

The following directions *for restoring animation* will be found useful:—

Seize the tongue with forceps and draw it forwards, taking care in doing so not to depress the chin more than is necessary. Compress the sternum forcibly, allowing it of its own elasticity to expand; do not wait for the respiration to cease before doing this, for when alarming symptoms are observed it is only by prompt action that these cases can be saved, and by making the respiration more forcible by artificial means in this early stage, the heart may be stimulated.

By Nélaton's method.

Give directions for the pillow to be removed from beneath the patient's head, and if, after two or three compressions of the chest, matters are improved by this treatment, continue it, if not, *give directions for the patient to be suspended by the legs, head downwards, continuing the respiration by placing one hand on the back and the other on the sternum.* (This is called Nélaton's method.)

Whether in these cases of alarming syncope under chloroform the heart be over-distended with venous blood, which it is too feeble to send on, or whether, through dilatation of the abdominal vessels, the heart not being filled has no blood to send on, cannot here be discussed, nor can any argument be entered into as to whether by Nélaton's method of total inversion, the blood is sent direct to a previously anæmic brain, or whether it is simply poured from the relaxed abdominal vessels, through the inferior cava to the anæmic heart.

But of this there is no doubt, that Nélaton's method of total inversion of the body, combined with artificial respiration, is the most efficacious remedy for severe syncope under chloroform.

As a rule, the pulse and respiration are immediately improved by this plan, but it frequently happens, that when the patient is replaced in the recumbent position, the pulse and respiration, which have been restored by the inversion, again cease; it is advisable therefore to be prepared again to invert the patient if it appears necessary.

Other methods of restorat.on. Though Nélaton's method appears to be the most efficacious, there are other remedies which have proved serviceable, mention of which must not be omitted, especially as the total inversion of a heavy patient is not always practicable.

Sylvester's. Sylvester's method of artificial respiration (*vide* p. 370) is of great use, and has been successful on many occasions. Before commencing this, or any kind of artificial respiration, the tongue should be drawn forward, and held with forceps to prevent its forming an obstruction to the entrance of air.

If this does not at once succeed, it, or Howard's plan, should be continued, and if necessary, persevered with for half an hour, or so long as there is any hope of recovery.

Faradisation. The faradic current may be applied, one pole being placed at the epigastrium and the other at the right side of the neck, to try to induce the diaphragm to act. The application of the electricity should be discontinued while the chest is being compressed, and applied while the arms are being raised, in order to imitate natural respiration, and also because strong and continued currents appear rather to exhaust, than to restore muscular activity.

Ether or brandy may be injected hypodermically.

Warmth, etc. A hot water bottle may be applied to the feet, and friction to the legs; warm blankets should be thrown over the patient, and an enema of brandy may be given, or brandy may be given by the mouth as soon as swallowing is possible.

Some have suggested the opening of windows and doors, dashing cold water on the chest and face, and holding *nitrite of amyl* to the nostrils; all these remedies may be of avail in slight syncope, but are not to be relied upon in the more alarming cases.

As the administrator himself must attend to the artificial respiration, and not neglect it for one moment for any less efficacious remedy, he must let others apply the battery, etc., while he continues the respiration.

Nitrous oxide gas.

Protoxide of nitrogen, *nitrous oxide*, or *laughing gas* is the safest anæsthetic to administer, and the pleasantest to inhale. It is generally said to be without taste or smell, but it really has a slightly sweet taste.

How stored.

It may be obtained from its manufacturers, Barth, Coxeter, or J. H. Parkinson, compressed into the liquid form in iron bottles of various sizes, those which contain 50 gallons and weigh about 6 to 8lbs. being the most useful. As the label on each bottle shows its weight, both when full, and when empty, the quantity which any bottle contains at any time may readily be ascertained by weighing it.

The weight of fifty gallons of gas is 15oz., and this is generally sufficient for about 10 administrations, so that, on an average, each patient takes about 5 gallons by measure, or 1½oz. by weight.

At one end of the bottle is a screw, which, if slightly loosened with a hand spanner or foot key, allows the gas to escape at right angles through a nozzle, to which the apparatus employed in the administration is to be fastened. Before attaching the apparatus to the nozzle, ascertain that the screw is in good working order, by turning it on and off, for considerable force is sometimes required to start the screw of a fresh bottle, and then the gas is apt to come out with a rush, which may damage the apparatus, if it be attached.

If, on turning the screw, the gas does not come out freely, as is often the case in cold weather, a little warm water should be poured over the neck and nozzle of the bottle.

Apparatus for administration of the gas.

The apparatus which is generally used, consists of a tube, one end of which is to be attached to the nozzle on the gas bottle, the other is connected with a bag, from which leads another larger tube, ending in a stop-cock, just where it is attached to the face-piece.

The face-piece has two valves, which must be of sufficient size to allow free passage of inspired and expired gas.

One valve at the attachment of the supply tube allows free entrance of gas to the face-piece at each inspiration, but prevents any exit. The other communicates with the air, and through this the expired gas escapes, but no air can be admitted. Running round the edge of the face-piece is a small air bag, or cushion, which readily adapts itself to the shape of the face.

For the successful administration of gas it is of the utmost importance to exclude all air; this is insured by a well-constructed apparatus with good valves, and, above all things, by a well-fitting face-piece, which must be firmly held upon the patient's face, including both the mouth and the nostrils.

Its advantages. The nitrous oxide gas is very safe, and, being almost without taste or smell, it is not unpleasant to inhale.

Its administration is never accompanied or followed by any distressing symptoms, such as sickness, nausea, or headache; and it is not necessary to make any alteration in diet before or after its inhalation. Unfortunately, however, as it produces asphyxia, it is only suitable for short operations, such as extraction of a tooth, or the opening of an abscess.

Details of its administration. Before commencing the administration, all air should be pressed out of the bag, and the stop-cock near the face-piece closed; the bag may then be filled with the gas, and the gas bottle be placed within reach, so that the bag may be replenished when necessary. With nervous patients, it is a good plan to commence by holding the face-piece quite lightly on the face, allowing them at first to breathe air through it, and when they have become accustomed to this, the rest of the apparatus may be attached, care being taken not to press the face-piece too firmly down, until two or three inspirations of gas have been taken.

In about one minute, the breathing becomes slightly stertorous and the face congested, when the operation may generally be commenced; but if the nature of the operation be such that the administration cannot be continued during its performance, it should not be begun until after three or four stertorous inspirations, and slight lividity of the face. If the administration be continued beyond this, very great lividity occurs, with spasmodic twitching of the muscles, wide dilatation of the pupils, and probably opisthotonos, and in women, paralysis of the sphincter of the urethra.

The gas in dentistry. In giving gas for *dental operations*, it is necessary before commencing the administration to place a small prop attached to a string between the teeth to keep the mouth widely open; it must be placed as far as possible from the teeth about to be extracted, and be firmly fixed so that it is not in the way of the operator.

In addition to this, the administrator should be provided with a more powerful gag, with which he can quickly open the mouth during the anæsthesia, should the prop from any cause have been displaced.

Care must be taken that the teeth which are extracted are not left in the mouth, as there is great danger of their then getting into the larynx and causing fatal asphyxia.

After the completion of the operation it is better not to attempt to arouse the patient; if the prop be still held between the teeth, it may be left there until the patient has entirely recovered consciousness.

Any difficulty with the respiration is generally at once relieved by one or two forcible compressions of the chest, the recovery from the effects of the gas being very rapid. Faintness is best treated by the recumbent position.

Ether.

The ether which should be used for inhalation is that which in the Pharmacopœia is described as pure ether, that is, ether free from alcohol and water, and of the sp. gr. ·720; or what is much cheaper, and apparently quite as good, the anhydrous ether, made from methylated spirit by Macfarlane and Co., of Edinburgh.

Its administration.

It is scarcely necessary to mention its very volatile and inflammable nature, except as a caution against a lighted candle being held near the patient during its administration. Ether may be given in a towel folded into a conical shape to fit the face, or in a felt or leather mask containing a sponge; but when administered in this way it is very disagreeable to the patient, takes a long time to produce sleep, is accompanied by much struggling, is very extravagant, and from the large amount which escapes, is very unpleasant

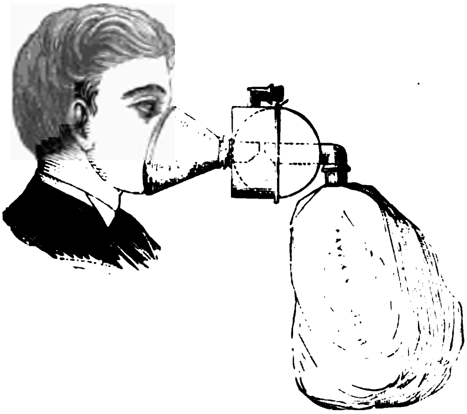

FIG. 179.—*Clover's Ether Inhaler.*

to every one who may be in the room, or, indeed, in the house.

Clover's apparatus for inhalation of ether.

The best, simplest, and most economical way of giving ether is by "Clover's Portable Regulating Ether Inhaler," made by Messrs. Mayer and Meltzer (Fig. 179 on previous page).

"The object of this instrument is to induce anæsthesia, in part by the diminution of oxygen respired, and to regulate the strength of the ether vapour, so that it may with certainty produce the degree of quietude wanted, and yet may not cause coughing or great difficulty of respiration."

Its construction.

Clover's ether inhaler consists of a face-piece with an indicator, which, by rotation, may be made to point to O, 1, 2, 3, or F. (Fig. 180), on the circumference of a metallic vessel containing fluid ether, and of a bag into and from which, the patient breathes.

It is so constructed, that when the indicator is at O, the expired and inspired air passes to and from the bag, without in any way communicating with the ether chamber.

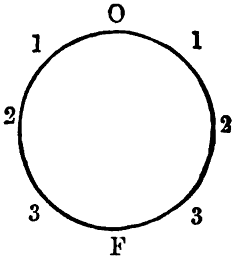

FIG. 180.—*Place of numbers upon Ether Vessel.*

If the indicator stands at F, the whole of the air expired passes through the ether vessel into the bag, and at inspiration, returns from the bag through the ether vessel.

When the indicator is at 2, half of the respired air passes to and from the bag direct; the other half passes through the ether vessel; and so on for the other numbers.

The air does not pass through the ether, but simply through the vessel containing it, and this is sufficient to carry off a large amount of its vapour.

Method of administration with the inhaler.

Having poured into the vessel an ounce and a half, or two ounces of ether (which is about two-thirds of the quantity which the measure supplied with the instrument is capable of holding), and having fixed the different parts of the apparatus together with the indicator at O, the face-piece should be applied lightly to the patient's face; it should be raised slightly during each inspiration, and held more firmly during expiration, until the bag is moderately distended, when it is no longer necessary to raise it. The ether vessel should now be rotated so as to bring the indicator nearer to either of the figures 1.

Let us suppose each of the intervals between O, 1, 2, etc. to be divided into six *spaces*. It will be found sufficient to rotate the vessel one space at a time. The rotation may be continued during every second or third expiration, unless the patient shows any signs of discomfort, when it is advisable to rotate the vessel back a little.

It is necessary to turn on the ether very gradually, or it cannot be freely inhaled. Should the bag become empty, as often occurs if the face-piece be not applied sufficiently firmly during expiration, it should be raised for one inspiration, and re-applied in time to catch the expiration.

Need of fresh air.

It must be borne in mind, when using this instrument, that so long as it is applied to the face, there being no communication with the external atmosphere, the same air is respired over and over again, so that it is necessary to frequently remove it for an inspiration of fresh air. As a rule, while anæsthesia is being induced, an inspiration of air should be admitted every half minute, and when it has been induced, every three or four inspirations from the inhaler should be followed by one from the air.

Allowance must of course be made for the degree of tolerance of the vapour which exists in different individuals; if the respirations are very shallow, it is well not to increase the vapour quite so frequently as when they are full and forcible, which indicates that no irritation is being produced.

If there be intolerance.

Should the patient show any signs of intolerance of the vapour, it is generally sufficient to admit one inspiration of air, and for a time to give the vapour less strong. When given in this way, there is not as a rule any struggling, and if such occurs, it may at once be cut short by admitting one inspiration of air, and then rotating the ether vessel two spaces instead of one.

In warm weather it is rarely necessary to go much beyond figure 2, or in cold weather, beyond figure 3.

Chief indications of anæsthesia.

After inhaling for two to three minutes the anæsthesia is complete. There is at first considerable congestion of the face, sometimes slight lividity, which soon passes off on the admission of a little more air. Slight reflex action may be produced by touching the conjunctiva.

The chief indication of complete anæsthesia is the deep snoring. There is sometimes a slight spasmodic twitching of the muscles which is apt to lead the beginner to imagine that the patient is not fully under. By giving the vapour more strongly the twitching will be found to increase, with, perhaps, spasm of the larynx, lividity, and dilatation of the pupils. But if, on its occurrence, air be admitted more frequently, these spasmodic movements soon pass off.

Continuance of anæsthesia.

When the patient has been under the influence about two minutes, it will be found that it is not requisite to give the ether vapour so strong to maintain the anæsthesia, as it was to induce it, and that the ether vessel may with advantage be rotated backwards. The longer the anæsthesia is maintained, the less ether is required, and the more frequently should the inhaler be removed to allow inspirations of air.

After about ten or fifteen minutes, it will be found necessary to add another half-measure of ether.

Any disturbance of pulse or respiration may generally be remedied by diminution or discontinuance of the amount of vapour, and the respiration may often be improved during very profound anæsthesia, by drawing the chin away from the sternum.

Combined administration of nitrous oxide and ether.

Clover's gas and ether apparatus.

It is often said of instruments intended to serve many purposes, that they are ill adapted to accomplish any one of these ends satisfactorily, but this saying cannot be applied to *Clover's gas and ether inhaler* (Fig. 181), which is most ingeniously devised for the administration of these anæsthetics, separately or combined. It may be used for the administration of gas alone, or with any desired amount of ether vapour, or for ether alone, or for ether with air, all of which purposes it serves extremely well.

The advantages of the combination.

The advantages of commencing with gas before giving ether are, that it is less disagreeable to the patient, that total anæsthesia is produced in a minute, or a minute and a half without any struggling, that in short cases the recovery is more rapid, less ether having been inhaled, and that it is less likely to be followed by sickness.

The advantages of the apparatus.

The advantages of this particular inhaler are, that the gas being turned on with the foot, leaves the administrator one hand free with which he may watch the pulse and steady the head, and that after a few inhalations of gas, without any removals of the face-piece, the ether may gradually be turned on, so that a mixture of gas and ether is inhaled before anæsthesia is complete. For although with ordinary inhalers it is possible to give gas until anæsthesia is produced, and then to substitute an ether inhaler; no ether having been inhaled during the production of anæsthesia it is in many cases impossible in this way to get sufficient ether into the patient to continue the anæsthesia of the gas, before partial recovery from its effects have taken place, sufficient ether only having been inhaled to produce struggling.

The late Mr. Clover himself preferred keeping the apparatus in a tin box, in one corner of which the gas bottle was fixed ready for use, but the advantage of fixing the gas bottle in a tripod with folding legs is that it enables it to be carried in an ordinary black leather bag, which attracts less attention.

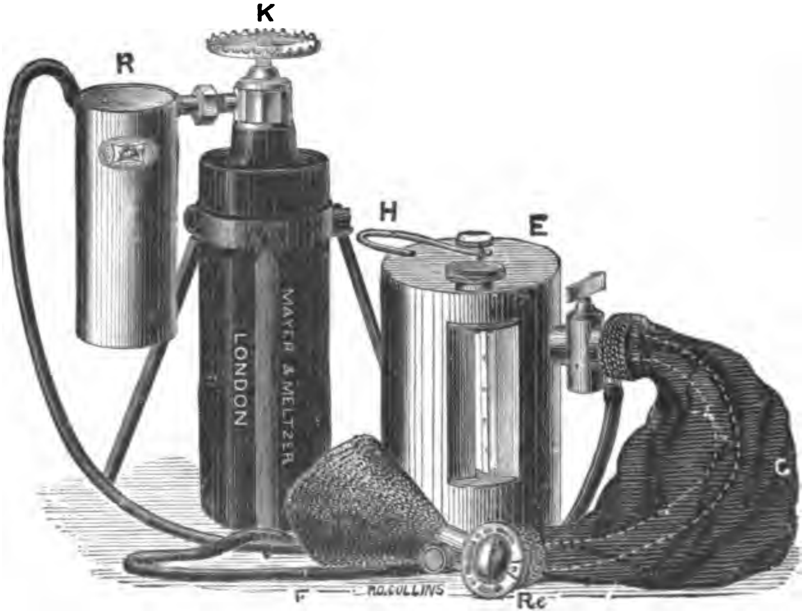

FIG 181.—*Clover's Gas and Ether Apparatus.**

Description of apparatus

The apparatus is made by Messrs. Mayer and Meltzer, and consists of a thin india-rubber bag, at one end connected, and communicating with the ether vessel, at the other, with the face-piece. Inside the bag there is a flexible tube, indicated by a dotted line in the figure, also connected and communicating with the ether vessel and face-piece. The communications of the ether vessel with the tube and bag may simultaneously be opened or closed, by turning the one stop-cock which is situated at their junction.

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* F, Face-piece; Re, Regulator; G, India-rubber Bag; E, Ether Vessel; H, Hook to attach the latter to a strap passing round the administrator's neck; K, Foot-key; R, Gas Rarifier.

The communications of the face-piece with the bag and tube may be opened and closed by rotating the dial-like regulator, Re. As the communication with the tube is opened, that with the bag is closed. By rotating the regulator, the letter G, E, and A, may successively be brought into view. When only the letter G is visible, the face-piece communicates with the bag, and through an expiration valve, with the outer air, but not with the tube. When only the letter E is visible (the stop-cock of the ether vessel being open), the face-piece communicates with the tube, through which expired gas or air would pass through the ether vessel into the bag; and at inspiration from the bag it will return through the ether vessel and tube to the face-piece. If this be compared with the former description of Clover's portable ether inhaler, it will be seen that except for the intervention of a tube between the face-piece and ether vessel, this is precisely the same action as takes place in the ether inhaler when its indicator is at F.

So also, the action of the regulator, when half-way between G and E, is the same as that of the former indicator at 2, when half the air passes direct to the bag, the other half having first to traverse the ether vessel before it can reach the bag.

It will be seen that the gas passes direct from the rarifier through a small flexible tube to the bag, and not to the ether vessel, to which, being of metal, this tube is attached for convenience only.

When used for gas alone.

When used for gas alone, the regulator is to be turned to G, the face-piece held firmly on the face to prevent admission of air, and sufficient gas turned on with the foot to moderately distend the bag. The expired gas will pass out through the expiration valve on one side of the regulator.

For ether after gas.

When used for giving ether, preceded by gas, 3 or 4 ozs. of ether must be put into the vessel, which itself must be placed in warm water until the thermometer stands at about 68° or 70°. After about six inspirations, administered as if gas only were to be given, the stop-cock of the ether vessel must be turned on, and the regulator gradually rotated towards E. When half way between G and E, the rotation of the dial, which has partly opened the tube and partly closed the bag, will have entirely closed the expiration valve, so that the gas must now be turned off with the foot.

The rotation of the dial towards E is to be continued after each inspiration until stertor is produced. After two or three such inspirations, it will be found necessary to admit a little air, either by raising the face-piece or by rotating the dial to E A.

From this time it is generally advisable to admit one inspiration of air after every four, and in about ten minutes after every two or three inspirations. If the ether be turned on too early, or too strong, it will cause the reflex movement of swallowing, or coughing, and perhaps struggling. If not turned on sufficiently early and freely, the long continuance of the gas generally occasions asphyxia, and spasmodic twitching of the limbs, which necessitates admission of air, and this in the early part of the administration is likely to lead to partial recovery and excitement.

It follows then, that although for the patient's comfort it is not desirable for the ether to be turned on very soon, yet, for the successful administration by this method, it must be turned on as early as it can be borne.

For ether only.

When used for ether only, the dial should be turned to G; the face-piece should be held firmly during expiration, and slightly raised during inspiration, until the bag has become moderately distended, when the face-piece may be held firmly upon the face, the regulator gradually turned towards E, and the administration proceeded with, as if gas and ether were being given.

When used for dental operations, if it be desired to prolong the effects of the gas by the inhalation of some ether, it will be found that this may be accomplished by turning on ether much later than in ordinary cases, as it is required during the last three or four inspirations only. The shorter time the ether is taken, the less giddiness is felt after recovery, and this is important when patients have shortly to leave the dentist's chair, and very probably his house.

Bichloride of Methylene.

Bichloride of Methylene (CH_2Cl_2) was introduced by Dr. B. W. Richardson in 1867. It is manufactured by Robbins & Co., of Oxford Street.

By Sir Spencer Wells it is preferred to chloroform.

Its nature.

In 1883, at a discussion in the Paris Académie de Médecine, concerning bichloride of methylene, M. Regnault said he had examined several samples, and found that certain products sold in France under that name were nothing but chloroform; others coming from England were a mixture of chloroform and methylic alcohol, and he asserted positively that the so-called bichloride of methylene procured from Sir Spencer Wells's provider, contained no trace of bichloride of methylene, though it was sold under that name. It was in fact a mixture of one part of methylic alcohol with four parts of chloroform.* (It should be mentioned that this substance is now sold under the name of "methylene," the formula $CH_2 Cl_2$ of the former label being omitted.)

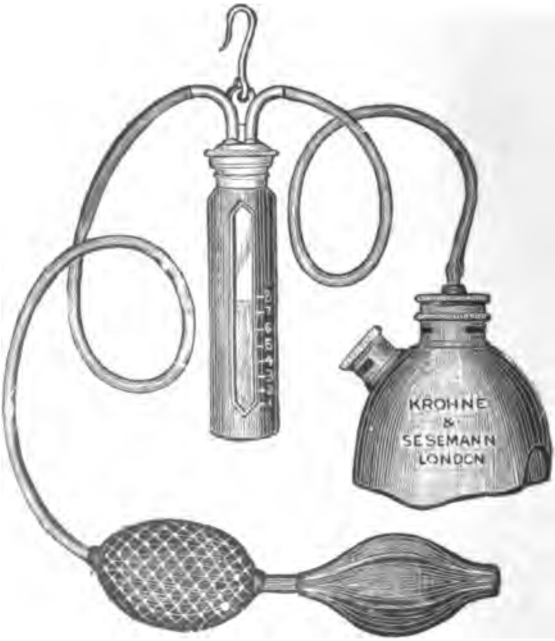

FIG. 182.—*Junker's Inhaler.*

How best given. This anæsthetic may be given with a perforated leather mask, but the best and most economical apparatus is Junker's, Fig. 182, which is made by Messrs. Krohne and Sesemann, Duke Street, Manchester Square. It consists of a bottle

Description of Junker's Inhaler.

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* *British Medical Journal*, July, 1883.

capable of holding about 2 oz. (the lower half being graduated up to 8 drachms), closed by an air-tight fitting top, through which two tubes are made to pass, a long one communicating with a Richardson's hand-bellows, and extending to the bottom of the bottle, and a short one commencing at the top of the bottle and connected by a flexible tube with a vulcanite face-piece.

In using the apparatus, about six drachms of the anæsthetic should be poured into the bottle, which is then to be hooked on to the button-hole of the administrator's coat (if more than six or seven drachms are put in, some of the fluid is likely, on forcible pressure of the bellows, to overflow into the face-piece). The face-piece should be held quite lightly over the patient's face, and very gentle pressure of the bellows should be made at each inspiration. The quantity of the anæsthetic vapour is regulated by the frequency and amount of the pressure on the bellows.

Can be used for chloroform, etc.

The advantages of Junker's anæsthetic apparatus, which is equally suited for the administration of chloroform or methylene, are, that as it occasions no waste of the anæsthetic, a much less quantity is required than in other methods, and that the vapour can be supplied with great regularity.

Anæsthesia for operations about the mouth, etc.

In operations about the mouth and nose, a plan (which has for some years been employed at St. Bartholomew's Hospital) will be found very useful, namely, of detaching the face-piece as soon as the patient is sufficiently under the influence of whatever anæsthetic may be employed for the operation to be commenced, and substituting a flexible metallic tube or gum elastic catheter, the former of which may be inserted into the mouth, the latter into the nostril. In this way perfect anæsthesia may be maintained, even throughout the longest operation, such as that for cleft palate, without causing obstruction to the operator.*

Ethidene Dichloride.

Ethidene Dichloride, ($C_2H_4Cl_2$), first used by Snow, was strongly recommended by the Scientific Grants Committee of the British Medical Association† as being intermediate in action between ether and chloroform, and was used in a great many cases by Mr. Clover. But, in addition to its expense, it appears to be rather unstable, and in some cases has caused great depression of the heart's action. Although it cannot therefore be recommended for general anæsthesia, it is of very great value for prolonging the effects of nitrous oxide gas in dental operations, for in these cases the small amount which is required (and this during the last three or four inspirations only) to very materially prolong the effects of the gas, is not sufficient to affect the circulation.

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* See *Lancet*, December 14th, 1878; *British Medical Journal*, May 19th, 1883. But in operations, such as for the removal of the tongue, or of tumours occupying the back of the pharynx, the practice is becoming more general of performing a preliminary tracheotomy, and maintaining the anæsthesia through the aperture, the top of the pharynx being plugged the while with a piece of sponge, so that no blood trickles down the trachea. (W.P.)

† *British Medical Journal*, December 18th, 1880.

Anæsthetic mixtures.

The "A.C.E." mixture.

In order to do away with the depressing effect of chloroform, and the disagreeable odour of ether, many combinations of these anæsthetics have been employed, the favourite being that which is commonly known as the "A.C.E." or the "1 2 3" mixture, which consists of—Alcohol, 1 part; Chloroform, 2 parts; Ether, 3 parts. But it must be borne in mind that this is merely a mechanical mixture. No new chemical compound has been formed, and it is a mixture of liquids of three different specific gravities, three different boiling points, and, although they are slightly soluble in one another, of different rates of volatility. It follows that in the employment of such a mixture care must be taken that it is quite fresh, and that no form of inhaler be used which will allow of the accumulation of the less volatile fluids after the evaporation of the lighter vapours.

Local anæsthesia.

[It remains for us to consider in this section the action of those substances which are used to produce local anæsthesia. The drugs which possess this power in any surgically useful degree are few in number, although many more, such as morphia, aconite, or menthol, when locally applied, have a distinct numbing effect.

The substances which we shall consider here are *Cocaine*, *Iodoform*, *Ether spray*, and *Carbolic Acid*.

Cocaine.

Cocaine may now be regarded as an established method of procuring local anæsthesia, and is the most valuable of all the drugs found on the short list of local anæsthetics.

The preparation used for local anæsthesia is the neutral hydrochlorate of the alkaloid *Cocaine* (or *Cucaine*), obtained from the leaves of *Erythroxylon Coca*. Its anæsthetic properties were discovered in connection with ophthalmic surgery by Koller, of Vienna, and its use was at first confined to operations about the eye, such as tenotomy for strabismus, ectropion, etc. Then its employment was extended to the throat for the purposes of laryngoscopy, and operations about the larynx and pharynx, and then to the uterus and urethra, and for minor operative purposes all over the body, its employment in some of which will be mentioned in the section on Minor Surgery.

Cocaine is applied as a watery solution, of a strength varying from 4 to 20 per cent. (or even more, as it is very soluble), which may either be painted upon a mucous surface (*e.g.*, over an internal pile), or injected into the submucous or subcutaneous tissues with a Pravaz syringe. The two methods are often employed together.*

The solution may also be applied as a spray, which may, if necessary, be maintained throughout an operation. A convenient form has been devised by Mr. Percy Dunn.

The anæsthesia takes from five to ten minutes to develop after the drug has been applied, and does not generally last longer than ten minutes. In all cases the solution should be freshly prepared.

Iodoform. The local anæsthetic power of *iodoform* is distinct although not very powerful. It is especially manifested when it is applied to the rectum, and iodoform dressings are very suitable after operations such as for *fistula in ano* in that region; but the sensibility of *all* wound surfaces is diminished by iodoform. The dry powder is the most effective form.

By the ether spray. Local anæsthesia may be produced by means of the ether spray (see the Formulary), which by its rapid evaporation, freezes and numbs the tissues.

By this spray the parts are rendered sufficiently insensitive for abscesses to be opened, small amputations to be performed, etc.; but the freezing and the thawing are themselves painful, and the frozen tissues are hard and awkward to operate upon.

For these reasons the production of local anæsthesia by the ether spray is losing rather than gaining ground at the present time. But when this method is adopted, the procedure simply consists in subjecting the place of operation to a spray of ether (a cheap kind of which is manufactured for the purpose), by means of a hand-bellows spray producer of the ordinary pattern, until the part is hard and white.

By carbolic acid. A very marked lowering of sensibility may also be produced by rubbing a crystal of carbolic acid, or painting the pure acid, liquified by 1 part in 20 of water, thoroughly into the area of the skin which is to be incised or punctured.

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* Thus Mr. F. S. Edwards states that internal piles may be absolutely painlessly operated upon after painting them on the outside with a 4 per cent. solution of Cocaine, and injecting one drop of the same into the centre of each pile. *British Medical Journal*, 1885, Vol. I., p. 227.

In this way abscesses may be painlessly opened, unless they are deeply seated, thorns extracted, aspiration performed, etc., without the inconvenience to the surgeon of an operation through frozen tissues, or the pain to the patient of the freezing and thawing.

Lastly it may be remembered that morphia may be administered to prolong the anæsthesia which has been produced by chloroform or ether, and that alcohol in doses insufficient to cause intoxication lowers the cutaneous sensibility to a marked degree, whilst in alcoholic stupor the tissues may almost be termed anæsthetic. W.P.]

SECTION VIII.

OF THE EXTRACTION OF TEETH AND THE MANAGEMENT OF AURAL CASES.

CHAPTER XXXI.

Of the Extraction of Teeth.

[For this chapter, as also for the description of the setting of difficult fractures of the jaws (pp. 161-164), we are indebted to our colleague Mr. H. H. Hayward, Dental Surgeon to St. Mary's Hospital.]

General considerations.

It falls within the scope of this manual to afford, in a compendious form, such simple instruction concerning the extraction of teeth as may be useful to those who may often, by their isolation in country places and in the army and navy, have to rely solely on the knowledge and skill they have, or should have attained, under the surgeon dentist during their student career. Although extraction is the operation which surgeons are called upon to perform most frequently, yet there are few which are so badly executed and which give rise to such anxiety. And all this would be avoided by a little careful attention in the third or fourth year of the curriculum. It is much to be desired that every candidate for the M.R.C.S. should be required to extract a few decayed teeth in the presence of an examiner attached to the Dental Board of the College of Surgeons.

It is assumed that the anatomy of the teeth, their correlation, and that of the jaws to the alveolar processes, etc., are fully known to the reader.

The extraction of sound teeth may become necessary in the deciduous, or temporary set, to make room for permanent teeth, or from malposition of, or serious injuries to the jaw bones or parts of the face, from diseases of the jaw, and to facilitate the removal of tumours. The extraction of decayed teeth of the second or permanent set may be necessitated from several of the above causes, and in addition, from toothache, and the provocation of disease in the tongue, cheeks and gums, through merely mechanical roughness, or ichorous discharges from sloughing pulps.

It is of the utmost importance that every student of this subject of the removal of teeth, should abolish from his mind the idea that either violent force, or indiscriminate wrenching are aids to a successful result. Such proceedings fortunately defeat themselves, but unfortunately the amount of torture inflicted on the victim at the time, and (in the young especially) the injury to the developing jaw and partially calcified teeth of the permanent set imbedded in the jaw, will very probably lead to lasting deformity.

Principles of extraction.

No mere verbal description of extraction can make even the most attentive student moderately proficient, without the frequent observation of the skilful operator, and the performance of the operation himself. Fig. 183 is a diagrammatic representation of an ideal jaw sawn through at the level which would correspond to that of those teeth which have more than one root or fang. On the right side of the drawing, a complete half set of the upper jaw is represented; it is unnecessary to diagrammatize the lower jaw, as the broad principle about to be explained applies equally to both.

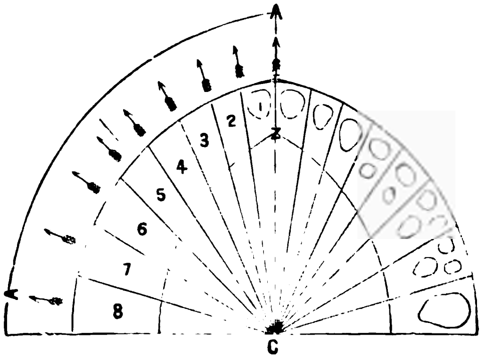

Fig. 183.—*Diagrammatic Section through Upper Jaw.*

Now, let the reader consider the left side of the drawing, and liken each of the section, numbered 1 to 8 inclusive, to the stones in an arch. If he were called upon to remove each separately, it is clear that they could not be pushed or drawn away, as the stones on either side would prevent this movement; it is equally evident that as each stone is narrower on its inner side than on the periphery, none of them could be drawn inwards without crushing one of those which are contiguous; hence the stones can only be moved wholly towards the outside on a radius from the imaginary centre C in the direction of each of the eight arrows = A to A.

Now let the reader look at the right half of the diagram, it will there be evident that the section of the fangs belonging to each tooth represents a wedge, the peripheral or outer side of which is wider than the inner; hence the teeth indicated by these fangs cannot be drawn inwards, but must be drawn outwards.

In addition to this mechanical comparison, which is constructed to explain the actual correlation of the teeth to each other and to the alveolar process, it must be added that, as shown in Fig. 184, in life, the layer of alveolus on the outer side of all the single fanged teeth and buccal fangs of upper bicuspids and molars, and of lower molars, except the third or so called wisdom teeth, is thin, elastic, and often incomplete, but on the inner side the alveolar process is thick and tough, and not only is never deficient in health, but is often most persistent in many forms of disease and in the aged.

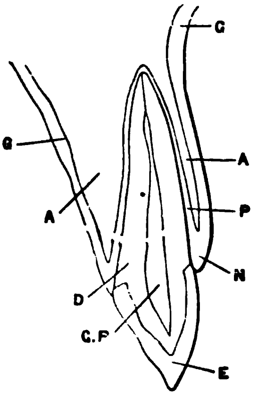

FIG. 184.—*Section through Upper Bicuspid and Alveolus.*

A A, Inner and Outer Alveolus; G, Gum; D, Dentine; E, Enamel; C P, Pulp Cavity.

We have now to consider:—

1. How to apply the above mechanical conditions to the extraction of teeth.

2. What instruments should be used.
3. How they should be applied.

Method of extraction.

Assuming the tooth to have been appropriately seized in the most suitable way possible, and by the best adapted instrument, it must first be pressed towards the outside of the jaw, in the line radiating from the imaginary centre C in the direction of that arrow which is nearest to the tooth which is to be removed.

The effect of this is to bend outwards and occasionally to split up the outer side of the socket, and at the same time to rupture the fibrous network of the peridental membrane on the inner or tongue side of each fang.

The next movement is to press inwards the tooth to its original position. This breaks partly or entirely, the tooth's periosteum—peridental membrane—on its outer side. Then by a repetition of these movements, always pressing the tooth more forcibly outwards, it is fully released from the periosteum, and the socket is sufficiently either bent or split so as to leave it free.

It must be sufficiently obvious that the action of pulling an upper tooth down or a lower one up, even when it is nearly released from its periosteal connections, is liable to many casualties, such as pulling the crown from the roots, or from some of them; there is also the risk of the tooth suddenly leaving its socket, and the instrument striking violently the teeth of the opposite jaw, which accident, so called, leads to the vertical fracture of one or more of them, if not a partial or complete destruction of the crown.

Complications of extraction.

The exceptions to the broad rule laid down of moving from the imaginary centre of the buccal cavity outwards and returning to it, are few and must be made in accordance with the results of abnormal anatomical arrangement of fangs, such as excessive spreading or radiation of the roots of a molar or bicuspid, or the coalescence of two or more of them, so as to form a ring grasping a portion of tough alveolar process.

Exostosis of the fang, again, or hypertrophy of the cementum, as it is more properly called, often converts the end of a fang into a bony lump, larger than any other part of it; in these conditions the operator will have a fortunate escape if he succeeds in wholly removing the tooth, by breaking away that portion of the alveolus, which is surrounding, or included in the fangs.

A fourth exception to the usual rule, is in the removal of the lower wisdom teeth, from jaws where all the other molars persist; as this tooth is under such circumstances seldom entirely erupted, and is embedded in dense bone close to the base of the coronoid process.

The instruments used in removing teeth, are of two kinds, viz., forceps and elevators.

Extraction of upper teeth.

(1.) Forceps are of almost endless variety, but the more experienced an operator becomes, the fewer he will use and teach the use of. Thus the best pattern for the upper incisors, canines, and bicuspids, is a pair with jaws straight from the hinge (which should be circular and not screwed up tightly), but sufficiently hollowed out and curved on the side nearest the tooth to be extracted, so that even if the fang be quite small, as an upper lateral often is, still the blades do not touch the crown of the tooth, while the bill clenches the fang at the edge of the alveolar process (Fig. 185). It is a great advantage for the handles of such forceps to be curved, as this will enable the operator to take out the ten anterior upper teeth without pinching the lower lip between the handle and the lower teeth. This form also has the great advantage of not requiring the mouth to be opened very widely—a boon to the patient who may have sore lips, or the muscles matted together by exudation or œdema—such forceps are known as "bayonet shaped," and further on

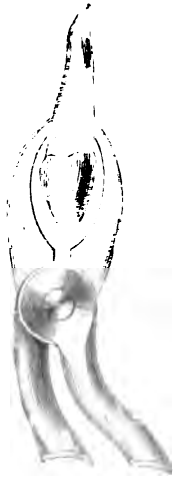

FIG. 185.—*Forceps for Upper Incisors, Canines, and Bicuspids.*

it will be explained in what manner this form may be used in the extraction of stumps even beyond the upper bicuspids.

Upper molar forceps (Figs. 186, 187) are necessarily curved both in the handles and the bills or blades, but the smallest amount of bend is to be advised, as the more an instrument is a direct extension of the hand the better.

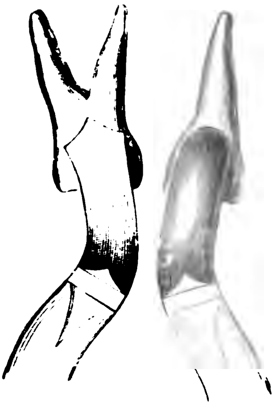

FIG. 186.

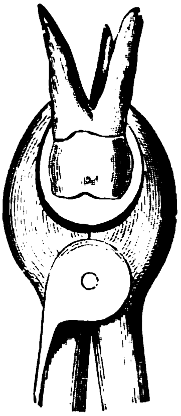

FIG. 187.

FIGS. 186, 187.—*Molar Forceps (in* 186 *the right hand blade is the inner one, the left hand, the outer).*

A normal upper molar has two fangs on the outer or buccal side, and one on the inner or palatal side. The forceps require only one concavity to grasp the inner or palate fang (Fig. 186), and two, with an intervening ridge or spine, to grasp the two buccal fangs and to aid in the insinuation of the forceps between the gum and neck and fang as far as the alveolar edge (Fig. 186).

The extraction of the third upper molar, or wisdom tooth, if all the other molars persist, requires forceps more curved in the blade and in the handle. The fangs are often agglutinated into a conical form, and the tooth being frequently small and deformed, a strong pair of stump forceps curved in both handles and blades is the most useful. It is usually advisable to avoid the use of the elevator in removing these teeth, as the tuberosity of the superior maxilla is often so very porous and riddled with tubes for nerves, arteries, and veins, as to break away very readily, and to bleed excessively, when fractured.

The difficulties that present themselves in the extraction of what is left of upper teeth, are chiefly that one or other or all sides of the tooth are decayed away, and are soft, so that there is no secure hold to be obtained of a large stump. In cases where one side is visible, is fairly hard, or can be reached by pushing that blade of the forceps into the socket, so as to use this strongest side of the fang as a director, and keeping the index finger of the right hand between the handles, so as to feel the way with the opposite blade into the socket of the more buried fang; such action if steadily pursued will often extract even the three fangs of an upper molar; should this fail, by the crushing together of the fangs, then a strong pair of bayonet-shaped forceps, as described before for incisors, etc., should be used, by inserting the inner blade, at a point where the fangs radiate, and the outer one upon the strongest outer or buccal fang; the removal of one fang will leave ample space for reaching the rest, pressing them towards the space vacated by the one removed.

Extraction of lower teeth.

Extraction of teeth from the lower jaw is most easily effected by using forceps with blades at right angles to their handles. Fig. 188 shows a lower bicuspid, grasped as it should be by an instrument which is equally adapted to the ten anterior lower teeth. This pair of forceps should not be very wide, as the lower incisors are frequently very narrow. The same principles are applicable here, as to the upper teeth, and for similar reasons; in a subsequent paragraph the position of the operator and the firm fixture of the jaws and head will be mentioned.

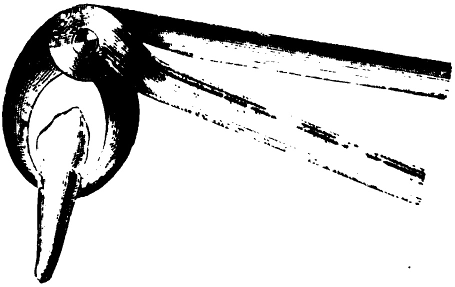

FIG. 188.—*Forceps for Lower Anterior Teeth.*

The removal of the lower molars, especially of the anterior, is the most frequent of all, and occurs earliest in life; the *modus operandi* is similar to that for uppers, except that the fangs usually are double and occasionally united, partly or entirely; in the former case they are more closely approximated at their apices, enclosing a tough portion of alveolus which requires much steady pressure outwards, and a firm hold of the tooth, to bend or break, failing either of which, the same kind of forceps as for bicuspids must be used, and each fang taken by itself.

Third lower molars require much care now and again in their removal. Their position at the root of the coronoid process and the density of the bone, and their distinct lean inwards, often renders it imperative to press the tooth towards the tongue as firmly as it will bear before the peridental membrane gives way, and ultimately to turn it entirely over on its own axis; occasionally the point or points of the fangs are so twisted, that turning the tooth backwards will alone release it.

Elevators. Elevators (Fig. 189, Nos. 1, 2, 3, 4, 5,) are of various patterns; the Author prefers the straight kind, as the most direct extension of the hand; and if so guarded by the fingers that hold it, there is no danger of the point slipping, and the operator always knows where that point is.

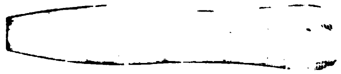

FIG. 189, No. 1.—*Straight Elevator, front view.*

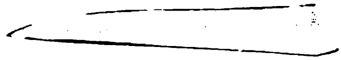

FIG. 189, No. 2.—*Straight Elevator, side view.*

Use of elevators. Whatever kind of elevator is adopted, it should be inserted into the socket of the fang to be removed, and pressed diagonally *downwards* and *inwards*, using that septum of alveolus between the fang and the nearest and firmest tooth, and the operator's own thumb as joint fulcra, ultimately turning the instrument on its own transverse axis. If possible the use of this or other extractors, such as fang dividers, should be avoided, especially on deciduous teeth, as injuries to capsule, socket, etc., may occur. Screws, keys, etc., need not be described in this manual, nor need they ever be used by the general surgeon.

As a general maxim, the patient's own statement as to the particular aching tooth should never be accepted without verification; an aching tooth is usually looser than any other, or is more sensitive to a sharp tap into, or across, its socket; or by probing, either an exposed pulp, or a purulent discharge can be detected.

Position of patient and surgeon.

The position of the patient should be facing a good light a little higher than the head, which, with the neck, ought to be securely placed, leaning a little backwards, in a firm heavy chair without wheels, or resting against a table; the operator should stand on the right side, out of his own light, in full view of his work, with a firm grip of the patient's jaw, especially of the lower one, so as to keep the head pressed against the chair-back. In extracting the lower teeth on the right side with right-angled forceps, it will be necessary to stand behind the head on that side, encircling it with the left forearm and hand, which latter must securely hold that side of the jaw back, and keep the lips and cheek from obstructing a full view, from the beginning to the end of the operation.

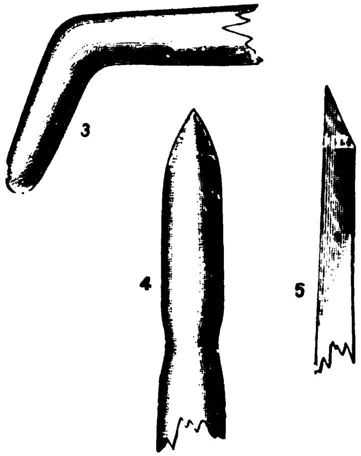

FIG. 189, (Nos 3, 4, 5). 3, *Curved Elevator, front view;* 4, *Pointed Elevator, front view*; 5, *Pointed Elevator, side view.*

CASUALTIES.

Casualties during extraction, or after.

The casualties that may occur in extracting teeth, which the general surgeon may have to deal with, are: (1) hæmorrhage, (2) dislocation of lower jaw, (3) fracture of teeth, (4) extraction of a tooth next to that removed, (5) extraction of the non-aching tooth, (6) tearing of the gum.

Bleeding.

(1) *Bleeding* to a serious extent may occur without any fault on the part of the operator, and may be entirely due to the hæmorrhagic diathesis. From whatever cause it may arise it is sometimes very difficult to arrest. The use of stimulants is to be avoided. Cold water or ice may be first tried. Clear the clot of blood from socket, wash it out with iced water, failing that, plug the socket tightly with lint soaked in tannin, or use perchloride of iron on the plug, which must in all cases be tightly jammed into the cavity, and allowed to project above the level of contiguous teeth, or so as to be forced into it by the teeth or gums of opposite jaw. Replacing the tooth, or even the forcible insertion of a soft deal wood plug hammered into its place may have to be resorted to.*

Dislocation of jaw.

(2) *Dislocation of the lower jaw* takes place usually on one side only, and more often during anæsthesia, especially from chloroform. It is best to reduce it at once. Wrap the thumbs into pads either with lint or napkins, place them firmly on the molars or upon the corresponding place in the jaw, hold the horizontal ramus securely with the fingers, push the jaw downwards and backwards till the condyle slips under the eminentia articularis, when it will jerk into the glenoid cavity. It will be well to bandage the lower jaw, with either a "four tail"† or a wide elastic bandage, for a few days.

Fracture of teeth.

(3) *Fracture of teeth.* If the remnants can be easily reached by fine, sharp-pointed forceps, it is better to remove them at once; but if much crushing of the alveolus is necessary, it is best to leave the broken fang till it rises to a convenient level, when it is often more or less loose.

Extraction of wrong tooth.

(4) *Extraction of the next tooth*, or (5) *extraction of a non-aching one.* Wash them in water of temperature of the blood; see that no coagulum remains; replace them in their sockets, and fix the jaw with a four-tailed bandage.

Tearing of gum.

(6) *Tearing of the gum.* If only slight it should be pressed into its place, when the elastic fibre in it, and the coagulum, will soon keep it in position, when it will soon reunite. If extensive, a few stitches will place it in a position for rapid reunion; occasionally a pad may be necessary, or a small vessel may have to be tied.

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* See also p. 38. † See Figure No. 62.

CHAPTER XXXII.

ON SOME POINTS IN THE PRACTICAL MANAGEMENT OF AURAL CASES.

[We are indebted to our colleague, Mr. G. P. FIELD, Aural Surgeon to St. Mary's Hospital, for almost the whole of this chapter.]

Deafness by impaction of wax.

Impaction of wax is a very common cause of deafness. To remove this obstruction nothing more than water at a temperature of 100° Fah. and a syringe is necessary. Sometimes, where the wax is very hard, it may be necessary twice or thrice to pour into the ear a warm solution of bicarbonate of soda (10 grs to the ℥j) at bedtime, before it is possible to remove the whole mass by the syringe. The patient should always stop up his ear with cotton wool after the removal of the wax. The syringe should be used gently and slowly, as the employment of much force will cause giddiness, and may rupture the membrana tympani, and for this reason a syphon tube, arranged somewhat upon the plan of the "nasal douche" shown in Fig. 22, is a very safe and convenient method. We should be careful not to give too favourable a prognosis in such cases, for masses of wax constantly increasing may lead to perforation of the membrane, to gradual dilatation of the osseous meatus, or to the formation of ulcers, or to worse evils. Moreover, impacted wax may cause thickening of the surface of the membrane, or even an abnormally deep position of it, with narrowing of the tympanum and over-pressure upon the contents of the labyrinth. Earpicks should be especially avoided, for severe injuries are often caused by these instruments, which, in the form of metal probes, hairpins, bodkins, knitting needles, etc., are used for the relief of itching in the ears, or for the removal of foreign bodies.

It is not uncommon to meet with patients who suffer from deafness due to a collection of epithelial laminæ, or what has been called "keratosis obturans," in contradistinction to "ceruminosis obturans" the impacted plug of ear-wax. The laminæ are derived from the horny elements of the external auditory canal by gradual accretion, causing great deafness and offering great resistance to removal.* In this affection we have always found the use of warm solutions of bicarbonate of soda, which we have before recommended for obstinate cases of hardened cerumen, the best treatment.

Wax in the ears of children.

The wax in the ears of children becomes sometimes fluid and highly offensive, a condition which, if not speedily attended to, is likely to lead to catarrhal inflammation, or more serious mischief.

Absence of cerumen in adults.

In adults, cerumen is sometimes entirely absent, but the deficiency appears in no way to affect the hearing power.†

Use of otoscope.

For the thorough examination of the meatus auditorius, or of the membrana tympani, some form of speculum or otoscope will be necessary. If a simple speculum be used, such as those which are shown in Fig. 190 (one attached to an otoscope), some form of concave mirror will generally be necessary. This may be either a hand mirror, or may be worn upon the forehead, or supported upon a spectacle frame so that both hands are free. In all cases there must be a

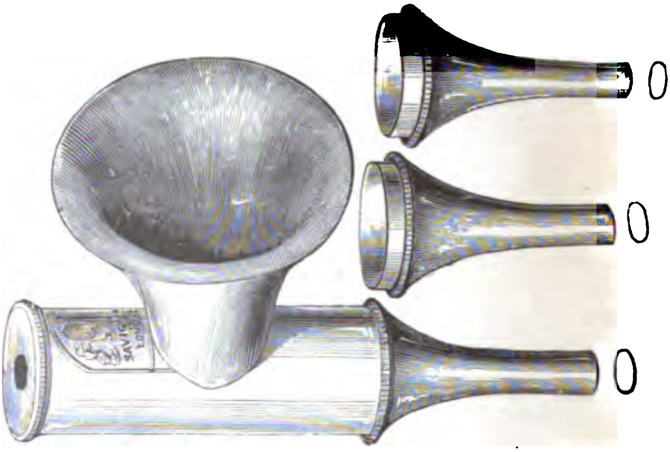

FIG. 190.—*Brunton's Otoscope, with Speculum attached.*

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* See "A Treatise on the Ear," by C. Burnett, M.D., pp. 293, 294; also Dr. Duncanson, *Edinburgh Medical Journal*, Nov. 1879, p. 477.

† Although the absence of wax does not in itself seem to have any ill effect on audition, a condition of unusual dryness in the external meatus is often associated with diseases of the internal ear.

small central aperture as in the ophthalmoscope or laryngoscope, through which the surgeon looks. A good light, either natural or artificial, is essential, and attention must be paid to the position of the patient. It is well also to remember that in the adult the meatus is larger in its vertical than in its horizontal meridian; whereas in children the reverse is the case.

Of Otoscopes, Brunton's (Fig. 190) is the one in most common use. In order to inspect the tympanum with it, all that is necessary is so to place the patient that the large conical speculum receives the light, while the surgeon can conveniently look through the end of the instrument. It requires little practice to use, and either sunlight, or an artificial light will do. The magnifying glass at the end can be used or not, at pleasure.

At times the removal of cerumen, pus, hairs, etc., is requisite, as they hinder a proper view of the membrana tympani. A pair of rectangular forceps, and a "cotton holder" (Fig. 191), are the most useful instruments for this purpose. The holder here figured consists of a wire in a handle, with the end fashioned into a screw with a very shallow worm, so that the cotton wool may be easily detached.

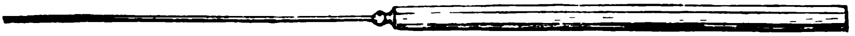

FIG. 191.—*Aural "cotton holder."*

Removal of foreign substances from the meatus.

Of the removal of foreign substances from the meatus. Generally speaking, the instruments introduced for this purpose do great mischief. Instrumental interference is hardly ever necessary, and is often dangerous. Careful and persevering use of the syringe and warm water will almost always be successful, especially if the auricle be pulled upwards and backwards. Where there is much swelling and inflammation of the soft parts (and this is often very severe from the irritation and pressure of the foreign body), it must, together with the acute pain, be relieved by freely applying leeches in front of the tragus, for the meatus and membrana tympani are extremely sensitive when pressed upon by hard substances.

Pain, how allayed.

After the inflammation has been allayed by this means, and also by the use of fomentations, the syringe will easily remove the foreign body; but we should by no means attempt the removal so long as the slightest tumefaction is present. Above all, it is necessary in each case to make a careful inspection of the meatus with the speculum to see whether there be actually anything to remove. Often and often have most lamentable results followed attempts to extract with instruments substances which have either never been in the ear at all, or which have fallen out of it unnoticed. Inflammation of the brain, and death, have not infrequently been caused in this way; or, if life has been spared, total deafness has followed.

Danger of instruments.

Vomiting and coughing are sometimes met with from irritation of the auricular branch of the pneumogastric (Toynbee). These symptoms instantly vanish when the pressure is removed. It is often advisable to turn the patient on his side and syringe from below, or as Hinton first pointed out, to "Place him on his back, if the foreign body, as frequently happens, be jammed into the angle formed by the anterior wall of the meatus and the membrana tympani."

The agglutinative method.

The agglutinative method of removal is strongly recommended by some authors; it consists of fixing the impacted body by means of glue or coaguline to a piece of linen attached to a holder, and withdrawing the same when the glue has firmly set on the foreign body. Adhesive plaster attached to a piece of string may be used in the same way. Lowenberg recommends that a camel's hair brush dipped in glue be applied to the foreign body and allowed to remain in the ear until firmly adherent to it, when the brush with the foreign body attached can be withdrawn.

The foreign substances we have most frequently met with in the meatus, are beads, small stones, peas, cherry stones, pieces of tobacco pipe and slate pencil, shells, paper, cotton wool, sealing wax and grass.

Beans, peas, and the like are very troublesome to remove, as they often swell from moisture and cause intense pain. But with most substances, rather than use any force in attempting to remove them, by far the better plan is to let them remain in the ear.

The foregoing remarks may appear unnecessary, but we can affirm that in nearly every case in which a patient has been brought to us with a foreign body in the ear, mischief has been caused by the constant endeavours of some anxious friend to get rid of the enemy by the use of a hair-pin, probe, or other instrument.

How to syringe the ear.

How to syringe the ear. Place the patient under chloroform, with the affected ear downwards, and syringe from below. Pull the auricle backwards and upwards (by this means the external auditory meatus is made into a straight tube), and apply the nozzle of the syringe to the upper wall of the passage. The water is then gently forced behind the obstruction, the foreign body is loosened, and by its own weight it will fall out of the ear.

Plugs may pass into tympanum.

Instances have occurred of cotton wool placed in the ear passing through a large perforation in the tympanic membrane into the Eustachian tube, and thence into the throat. Very small pieces of cotton wool, therefore, should not be put in the ear, especially if there be a hole in the membrana tympani.

Boils in meatus.

Circumscribed inflammation, or boils, in the external auditory canal are of frequent occurrence, and are generally met with in people of middle age. They are, as a rule, extremely painful. Some authors recommend pouring into the ear a strong solution of sulphate of zinc to induce their resolution, or the application of nitrate of silver. Poultices may be used, and are of great service if there is intense suffering. In all other varieties of inflammation they lead only to increased suppuration, and probably to perforation of the membrana tympani. Occasionally, blisters behind the ear are ordered; but these merely increase the irritation, and are of service only in certain cases of chronic discharge. In all acute forms of aural disease they should be avoided. Glycerine poured into the ear will often be found useful for relieving pain in these cases.

Insects in the ear.

Insects often enter the meatus. Syringing with warm water is all that is necessary to effect their removal and stop the irritation which they produce. It is very common to meet with patients who imagine they have insects in their ears. The common fly has been known to deposit its eggs in the ear. The larvæ produced sometimes give rise to severe pain. Warm oil poured into the meatus will usually have the desired effect on insects, and the vapour of chloroform will kill maggots. According to Dr. Barr* the latter "may be found in great numbers, chiefly at the inner end of the canal, and in the tympanum, appearing as white worm-like creatures, moving rapidly about. These larvæ are furnished with hook-like apparatus, which fasten upon, or penetrate the tissues. After they have been killed they may require to be removed with forceps."

Chronic inflammation of the external auditory meatus.

Chronic inflammation of the external auditory meatus often leads to narrowing of the passage, until the introduction even of a probe is an impossibility. Small indolent ulcers form, which keep up a constant irritation and give rise to a somewhat thick and offensive, but more frequently, watery and inodorous discharge. Mild astringent lotions may be prescribed, and tonics to keep up the patient's general health. A strong solution of nitrate of silver should be applied to the ulcerated surface by means of a very small probe and cotton wool, at least twice a week.

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* *Glasgow Medical Journal*, December, 1881.

In a favourable case the discharge and ulceration gradually disappear, and, the passage becoming widened, hearing is restored.

Molluscous or sebaceous tumours.

Molluscous or sebaceous tumours sometimes block up the meatus, and must be treated by removal of the capsule as well as the contents.

These tumours produce absorption of bone without occurrence of pain, and often cause enormous dilatation of the meatus. They sometimes make a clean cut hole right through a portion of the petrous bone; and they moreover not infrequently set up brain mischief, which may terminate fatally.

Insufflation of tympanum.

Of insufflation of the tympanum.

There are many morbid conditions of the Eustachian tube and of the tympanum in which a cure, or a great relief of the disease and of the want of power of hearing is afforded by the opening up of the tube, and the re-establishment of the connection between the pharynx and the tympanic cavity.

This may be done by the insufflation of air through the nostrils under certain conditions of the pharynx, or by the passage of a metal tube through the nares and top of the pharynx, into the aperture of the Eustachian canal, through which tube air may be blown into the tympanum, stimulating lotions injected, etc.

The instrument by means of which the direct insufflation is performed is known as *Politzer's bag.* The tube is called an "Eustachian catheter," and the method of using both of these must be briefly explained.

When useful.

As examples of cases in which Politzer's bag or the catheter proves extremely useful there may be instanced that very common catarrhal condition of the tympanic cavity, where the Eustachian canal becomes swollen and blocked, and the cavity may be filled with mucus, or in cases of more acute inflammation of the tympanum, with pus, which may be discharged by this canal when it is opened up. Speaking generally, the bag is used in children, and for the less severe disorders of the tympanum in adults, and the catheter for the more obstinate adult cases, or where it is desired to inject lotions, etc.

Politzer's ba

Politzer's bag (Fig. 192), is, as will be seen in the figure, an ordinary indiarubber, compressible bag, of a size convenient to be compressed by the hand. This is in connection with the tube which terminates either in a nozzle which may be inserted up one nostril, the other being closed by the finger, or, by what is far more convenient, a specially constructed nasal air pad (see the figure), which can be held closely against the apertures of the nostrils. Further, when the operation of "blowing up the tympanum" is about to be performed, the surgeon, by means of an indiarubber tube about 18 inches long, and which has a vulcanite or ivory ear-piece at either end, places his ear in connection with the ear which is to be examined by inserting one end into the external meatus of the patient and the other into his own ear. This tube is called a diagnostic or auscultation tube, and when air is forced through the Eustachian tube into the tympanum by means of the Politzer's bag, as the current impinges upon the tympanic membrane the surgeon hears through the auscultation tube a peculiar thud.

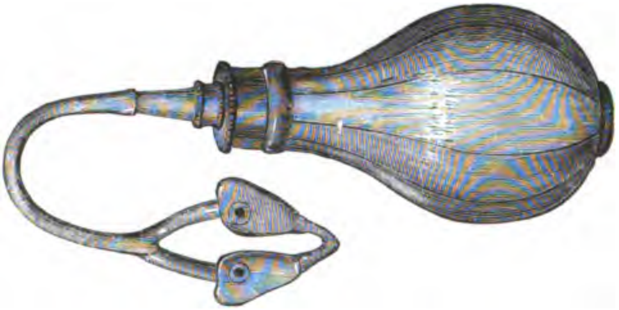

FIG. 192.—*Politzer's Bag, with Allen's Nasal Pad.*

And auscultation tube.

The other details of the method are as follows :—

Use of bag.

The operator stands or sits at his convenience, facing the patient. The end of the nasal pad is held firmly against the nose, and the patient is directed to swallow, and *while he is in the act*, the bag is sharply squeezed. Thereupon the air passes with a distinctly audible noise through the tube into the cavity of the tympanum.

Another way is to direct the patient to pronounce the syllables—*hack, heck, hick, hock, huck, hook*—during which time the bag is squeezed.

For young children, swallowing or articulation is often unnecessary, the bag being simply forcibly squeezed into the nostrils; or the bag may be dispensed with altogether, and warm air may be blown in from the surgeon's lungs through a piece of tubing. Many patients can very fairly satisfactorily inflate their own tympana by closing their mouth and nostrils and then swallowing forcibly.

If the Politzer's bag be used with undue force, damage may be done to the small vessels of the middle ear, Caution should therefore be exercised.

The Eustachian catheter. We come now to the consideration of those cases, where, to overcome an obstruction in the Eustachian tubes, whether this arise from the severity of the catarrh or some other cause, the Eustachian catheter must be employed.

Its passage. The passage of this instrument is a very important operation, and yet the ability to perform it is a rare acquisition.

How to pass the Eustachian Catheter (Fig. 193).—For young children the use of the Eustachian catheter should be avoided, being unnecessary, very difficult, and, moreover, on account of their restlessness, dangerous.

FIG. 193.—*Eustachian Catheter.*

By far the easiest and best manner of passing this instrument is that first suggested by Dr. Löwenberg. He recommended that, after reaching the pharynx, it should be turned inwards, till it became hooked behind the vomer, and, as it could then be withdrawn no further it should be turned completely round at right angles, its point being thus brought exactly into the mouth of the Eustachian tube.

If the instrument, after reaching the pharynx be withdrawn in the ordinary way, viz., with the point turned outwards, until the orifice of the Eustachian tube is found, great difficulty is frequently experienced. The instrument is withdrawn either not far enough, or too far, or perhaps its point is inserted into the fossa situated behind the Eustachian tube.

It should be remembered also that in catheter cases the mucous membrane is nearly always in a delicate state, and is often highly sensitive, so that constantly moving the instrument backwards and forwards adds considerably to the patient's discomfort, and may cause injurious effects.

If the following directions are carefully followed we believe that the attempt will almost certainly be successful.

Warm the catheter in hot water, depress the patient's lip, and introduce the catheter into the inferior meatus of the nose; pass it along the floor of the nares until it reaches the posterior wall of the pharynx, taking care to keep it at right angles with the plane of the face; withdraw it until the septum narium is felt; then rotate it with the point downwards to the opposite side, that is, turn it outwards and a little upwards (as shown by the position of the ring at the other end of the catheter), and it will be found to have entered the mouth of the Eustachian tube.

A catheter with a double curve, as first suggested by Dr. H. D. Noyes, is at times useful, as it can be introduced into the Eustachian tube from the opposite nostril.

Discomforts of use of catheter.

The employment of the Eustachian catheter is sometimes attended with disagreeable symptoms, such as pain, epistaxis, nervous cough, sneezing and irritation of the pharynx, which, however, are generally soon relieved. If the catheter be passed skilfully, more serious results are almost impossible.

Use of syringe, etc.

A syringe with a nozzle that fits into the larger end of the catheter is the instrument usually recommended for injection of fluids, and an air bag for insufflation, after the catheter has been passed. The surgeon, standing in front of the patient, holds the catheter with his left hand, and compresses the air bag with his right. But, as every time the bag is compressed the catheter is liable to be dislodged, its point may cause very considerable pain to the neighbouring tender mucous membrane. Again, if the left hand by any chance lets go the bag, the catheter will be forced very unpleasantly upwards. Such accidents are impossible by the following method:—The surgeon stands on the right side of the patient, and has the air bag (to which is attached a long indiarubber tube, the end of which fits the catheter) hanging by a loop from a button of his coat. Having passed the catheter, he holds it firmly in position by the left finger and thumb against the nose. When now the end of the tube is inserted into the catheter, the latter is not liable to be tilted upwards, nor is the surgeon's hand or the weight of the bag felt by the patient in the slightest degree.

Digital examination of naso-pharynx.

With regard to the *digital examination* of the Eustachian tube, Dr. W. H. Wynne has lately remarked as follows: "The naso-pharynx, therapeutically, is the most important part of the ear. The method of digital examination consists in passing the index finger of the right hand, when the right tube orifice is to be examined, into the mouth, up and behind the soft palate to the orifice, which can easily be distinguished by its slight depression, the operator standing on the right side of the patient. In examining the left tube the order is reversed. The time of the investigation varies from half a minute to three minutes, and disease of any of the structures that can be examined is immediately determined. This method can be used in cases where, from complications, the use of the rhinoscopic mirror is either unsatisfactory or impossible. By its use I can immediately determine the normal or pathological condition of parts within reach of the finger, namely, the pharyngeal orifice of the Eustachian tube, the posterior fossa of Rosenmüller, Luschka's tonsil, occupying a central position in the posterior wall of the pharynx, and terminating laterally in this fossa, and the posterior nares in front; and here by the digital examination I am able to diagnosticate the existence of polypi and hypertrophy of the membranous covering of the inferior turbinated bones."*

Aural polypi.

Varieties and structures of aural polypi. According to their histological characters, aural polypi may be divided into the following classes:—(1) Granulation tissue; (2) Mucous; (3) Fibrous; and (4) Hyaline myxomatous, polypi.

(1.) The "*granulation*" *tissue polypi* are reddish, rounded, soft, and very vascular tumours, varying from the size of a pin's head to that of a pea or somewhat larger.

(2.) The *mucous polypi* manifest a rather higher stage of development, and in structure resemble somewhat the fœtal skin at about the fifth month of embryonic life.

(3.) The *fibrous polypi* are rarer than the last, and consist of laminated epithelial cells on a bed of fibrous tissue.

(4.) *Hyaline* or gelatiniform polypi are soft, semi-transparent nodules pervaded by vessels which can easily be teased out. They are the rarest of all these tumours.

Etiology and situation.

Etiology and situation. Aural polypi are, as a rule, the result of long-standing otorrhœa. They occasionally arise from the walls of the external meatus, or even from the membrana tympani or Eustachian tube, but most commonly from the tympanum. They make their way out through a perforation in the membrana tympani.

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* "Practical Deductions drawn from a Thousand Digital Examinations of the Pharyngeal Orifice of the Eustachian Tube." *Boston Medical and Surgical Journal*, November 17th, 1881.

Treatment. The smaller polypi may be destroyed by the constant application of caustics. For some of the softer kinds, sulphate of zinc, in strong solution, or, perhaps preferably, this with carbolic acid (āā gr. v. ad ℥j.) answers very well; but for the great majority of cases, no other treatment is so successful as the removal by a Wilde's wire snare (Fig. 194), the noose of which can generally be adjusted with ease around the pedicle of the growth, which can then be quickly strangulated and divided by the tightening of the wire. A successful termination is not to be expected without careful treatment after the polypus is removed, and cleanliness is most essential. If the discharge be allowed to go on unchecked after the operation, and no steps are taken to get rid of the accumulated secretion in the tympanic cavity, another polypus is likely to spring up in a short time.

Wilde's snare.

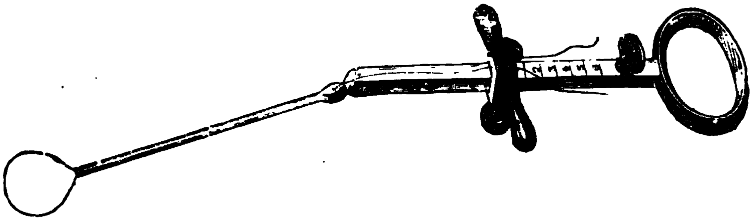

FIG. 194.—*Wilde's Snare.*

Caustic after removal. In all cases after the polypus has been removed it is necessary to apply to its site a strong caustic, *e.g.*, solution of nitrate of silver (480 grs. to ℥j.) on cotton wool, on a suitable holder. Very little pain will be caused if the greatest care be taken to touch only the small spot from which the polypus springs; it is therefore best to guard the meatus with a speculum, and to use a strong light.

SECTION IX.

OF THE MINOR OPERATIONS OF SURGERY AND KINDRED SUBJECTS.

CHAPTER XXXIII.

OF THE EVACUATION AND TREATMENT OF ABSCESSES.

THIS and the following chapters deal with the opening and drainage of abscesses, and of synovial and bursal sacs, by incision, aspiration, or by other methods, and with the tapping (paracentesis) of the more important serous cavities, as the pleura, peritoneum, or tunica vaginalis testis.

Of abscesses.

We will briefly consider first the general rules which govern the treatment of all abscess cavities, and will then pass on to the special points which arise in connection with the more important special forms of this condition, as whitlow, mammary abscess, and the like. The subject of the evacuation of pus or other fluids in pre-existing cavities, such as the pleura, will follow later.

General considerations as to the opening of abscesses.

It will occasionally, but rarely happen, that abscesses may properly be left to open of themselves; and more frequently chronic abscesses may be allowed to remain unopened for an indefinite period. But broadly speaking, the essence of the treatment of these collections of pus consists in opening and emptying them in the most appropriate way.

Ways of opening abscesses.

The chief ways in which abscesses may be opened are (1) by a simple incision, (2) by incision with laceration of deeper parts with forceps, or a director (Hilton's method), (3) by a trocar and cannula, (4) by aspiration. Further, the opening into the sac may be a single slit or puncture, or a counter opening may be required as well. Again, it may be that all that is required is a simple incision, but more frequently, and for large abscesses almost invariably, it will be necessary to arrange for subsequent drainage.

By incision.

Still, speaking quite generally, we may say that for acute abscesses, *direct incision*, with or without subsequent drainage, is the usual course; while chronic collections of pus are evacuated either by the aspirator, or by a trocar and cannula, or if a freer opening be called for, this is made, and the parts are afterwards dressed antiseptically. The use of the grooved needle, or of the well-known fine exploring trocar, or of a syringe like that used for hypodermic injections, is almost entirely confined to exploratory punctures for diagnostic purposes.

Methods of incision.

With regard to the ordinary methods of *incision* of abscesses, little need be said beyond that which common sense would suggest. The curved scalpel, generally called a "Syme's" knife, is often recommended, but we believe that in most cases a straight blade is better. For large sacs a common dissecting scalpel will be the most convenient form, and for small ones, especially if somewhat deeply seated, a narrow-bladed, double-edged lancet pointed knife is best;* sometimes the instrument which gives the least pain, from the extreme thinness of its blade, is the old-fashioned bleeding lancet.

But whatever knife be used, common humanity should insist upon its being very sharp, and the dresser should endeavour to open all abscesses, save those which present some anatomical reason for dissection or delay, as quickly as possible, making up his mind beforehand how far, how deep, and in what direction, the cut is to be made, in order that one movement of the hand and wrist may suffice.

Direction of incision.

With regard to the *direction*, the rule is that incisions should be made in the long axis of the trunk or limbs, unless there be any reason to the contrary, but that in any case they must be parallel to, and not across the direction of structures which it is desired to avoid.

Selection of place of opening.

As a rule, abscesses, especially acute ones, must be opened where they point, and this is very often not the spot which would be chosen by the surgeon, who would prefer to make his opening at the most dependent part; this may necessitate the making of a counter opening, by passing a director through the sac from the upper pointing aperture to the bottom of the cavity, and cutting down

Counter opening.

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* This knife has many names. At Bartholomew's it is called a "Paget's knife."

upon the point of the instrument, so held that it can be felt there through the skin.

Detection of pus in deep seated abscesses. When an abscess distinctly points, there can be no difficulty in recognising the condition of affairs, but in deep seated collections of pus, it often happens that the spot where it comes nearest to the skin, is indicated, not by an elevation, but by a peculiar sensation to the finger, a mixture of bogginess and dimpling, which we can compare to nothing better than to the feeling conveyed to the finger when it is passed over the keyhole of a door with three or four folds of some soft stuff (say a handkerchief) intervening.

By fluctuation. The recognition by fluctuation of deep seated collections of pus, or of any other fluid, which is not making its way at any point to the surface, is a matter of tactile education, which every student must most earnestly and diligently set himself to acquire by practice on every possible occasion, and which can in no wise be taught by words. One extremely common cause of error we will caution the beginner against, namely, that he should always "try for fluctuation" with both hands placed along the long axis of muscles, and never across their fibres. The most perfect fluctuation may be felt by placing the fingers across the belly of such a muscle as the quadriceps extensor femoris, and a tyro may well be thus deceived into the belief that fluid is present.

Opening by Hilton's method. When pus is deeply seated, and especially if it be in the neighbourhood of important vessels, etc., a single plunge of the knife will often be too dangerous. In abscesses, therefore, such as those beneath the deep cervical fascia, or in Scarpa's triangle, a method of free opening may be adopted, which is generally called after the late Mr. Hilton, who strongly advocated it, although it is difficult to believe that the manœuvre was not known before his time.

The plan consists in making an incision as far down as is considered safe, and then, by introducing a pair of dressing forceps, and burrowing with them in the direction of the pus, alternately opening and closing their blades, a lacerated tunnel or passage is safely made down to the sac of the abscess. When it is reached the blades of the forceps should be opened, so as to thoroughly enlarge the opening in the sac by tearing. A free exit is thus secured, which may afterwards be maintained by drainage tubes, etc., when necessary.

But in whatever way acute abscesses are opened, it will be necessary to provide for their being thoroughly emptied and kept aseptic. If they are small this will not be at all difficult, and even with large acute abscesses it will very often be found that it is sufficient to wash out the cavity three or four times a day (if there be a free opening), and that no especial arrangements of drainage tubes, counter openings, etc., are called for. But should this not be the case, they must be managed in the same way as the chronic ones to be directly considered.

Generally speaking, acute abscesses are poulticed, or covered with some moist absorbent dressing, such as spongiopiline, but the choice of the dressing which would be most appropriate in any particular case, can hardly be reduced to rules.

Of chronic abscesses.

Chronic abscesses do not call for evacuation in consequence of constitutional irritation or fever due to mechanical retention of pus, but for some less urgent cause, so that the opening is made more deliberately, and is not followed by that marked, almost instantaneous alleviation of symptoms, which is characteristic of the opening of an acute abscess.

Chief ways in which they are opened.

The chief ways in which a chronic abscess may be opened are:—

(1.) By simple incision, or by Hilton's method, as for acute abscesses.

(2.) By free incision, and, if necessary, counter incision, performed with strict antiseptic precautions.

(3.) By some form of aspirator.

(4.) With a trocar and cannula.

Incision.

Free incision with the antiseptic precautions before described, is now a very common treatment. In all the details of the dressing, and in every other particular, the arrangements are the same as have been previously detailed.

Place of incision.

With regard to the opening, it should be made by preference in a dependent place, or a drainage tube may be passed through from an upper to a lower opening. In fact, any of the methods of draining which have been described in the Section on wounds may be employed.

If it be thought advisable, the cavity may be washed out, but even without this precaution, a large abscess may be kept perfectly aseptic for an indefinite time under the antiseptic dressing.

By aspiration.

Of *aspirators* there are several kinds, but they are mostly modifications of Dieulafoy's, shown in Fig. 195, except in the case of small instruments which are used chiefly for exploration, in which the fluid enters the barrel of the syringe, and is thence expelled, by a special arrangement of taps. Smaller syringes still may be used, down to the ordinary hypodermic syringe, by means of which the nature of obscure swellings, or the existence of fluid in such situations as the pleura, or the liver, may be safely proved or disproved more easily than would otherwise be possible.

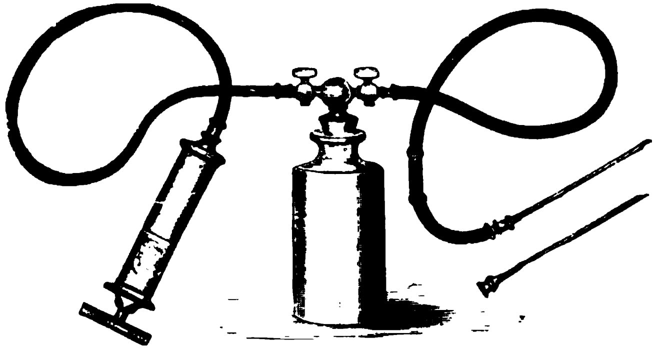

FIG. 195.—*Dieulafoy's Aspirator.*

Before using any aspirator, its connections must be seen to be air tight, and the powers of the syringe to maintain a good vacuum should always be tested.*

Method of puncture.

Whether the actual puncture be made with a fine trocar and cannula, or with a pen-pointed hollow tube, it is very important that the needle should be sharp, if not, there will be great risk of its pushing some piece of tissue, false membrane, etc., before it, so that it is blocked at once, and completely. This tendency to blocking of the aspirating needle is the great drawback to the apparatus, and must always be kept in view.

With regard to the actual insertion of the needle, few general directions are called for. The depth to which the operator wishes to go must be decided beforehand, and the finger should be placed upon the needle to serve as a guide. The cavity should be punctured quickly, so as to avoid pushing the sac wall in front of the point of the instrument, and the direction of the needle should always be perpendicular to the surface of the tumour.

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* It has been ingeniously suggested by Dr. Barraclough (*Lancet*, 1884, Vol. II, p. 1077), that in the absence of a regular suction syringe and fitted receiver, an aspirating apparatus, with a bottle possessing a very good vacuum, can be improvised by immersing an ordinary "syphon" soda water bottle up to its neck in boiling water, the tap being kept open the while, until the air is expelled. The tap must be closed before the bottle is removed from the water. When it is cool, if the tap be connected with the indiarubber tube which is joined to the aspirating trocar, upon opening the tap a powerful "exhaust" will take place.

Chronic abscesses which do not at the time they come under observation depend upon any active cause for the continued formation of pus, are sometimes treated by emptying them, and then injecting some stimulating fluid, with the object of altering the character of their walls. This treatment has certain risks of its own, but it is often very successful. The fluid generally employed is the diluted tincture of iodine, of various strengths; this is injected into the cavity with a syringe, after the pus has been evacuated, and the sac washed out. Sometimes a small quantity of the pure tincture (or the stronger preparation known as the Edinburgh tincture), is injected and allowed to remain in, but more often a quantity sufficient to distend the abscess, of a more dilute solution, is forced in, and then allowed to escape.

Other fluids, as carbolic acid, or chloride of zinc, about 1 in 20, etc., are also used.

By a trocar and cannula.

Ordinarily speaking the common trocar and cannula is not a convenient way of evacuating abscesses, although for the removal of fluid from the serous cavities, as from the pleura or tunica vaginalis, its use is very general. For abscesses proper, its use is almost limited to the emptying of small collections of matter where the diagnosis has been somewhat doubtful, or which are very deeply or awkwardly seated.

Bleeding into the abscess cavity.

The last general point to which we will advert in this question of the treatment of abscesses is that of *bleeding into the sac.* As soon as the internal pressure of the fluid contents is removed, it naturally happens that bleeding from the vessels in the abscess wall may occur. When an abscess is opened, therefore, care should be taken that the parts are not squeezed or roughly handled. The sudden relief of pressure, even without manipulation, may often enough result in a bleeding into the abscess, sufficient to cause delay in its complete evacuation. In most cases, the blood clots become disintegrated and broken down, and escape as *débris* when the sac is syringed out, so that moderate pressure is all that is required; but sometimes the bleeding assumes a more serious form; a blood-vessel of some size may be running through, or in the walls of the abscess, and may be eroded; or a vessel may have been wounded in the opening, or the walls may be in a dangerously sloughy or congested condition. From any of these causes it may happen that the sac of the abscess becomes distended with blood-clot, while from the aperture there is a trickling stream of fluid blood, which serves as an evidence that bleeding is still going on.

Its treatment.

We have here *inside* the cavity those conditions of distension and high temperature which most favour hæmorrhage, and unless the sac can be emptied of the clots through the existing opening, the only course is to enlarge it and to turn them out. Under no circumstances should an attempt be made to plug the mouth of the sac, or to inject any fluid, such as the liquid perchloride of iron, into it, with the idea of acting on its lining membrane; but the clots once removed, if moderate pressure be applied the bleeding will at once cease.

We come now to the consideration of the points which arise in connection with the opening of some of the special kinds of abscesses.

Deep cervical abscess.

Deep Cervical Abscess. The early recognition of the presence of pus beneath the deeper fasciæ of the neck, is of the highest importance, yet sometimes it is extremely difficult; the pus is so confined, and so deep, and there is often so much general swelling, that fluctuation is hardly to be made out, while nowhere is there anything like pointing. But pus in this region must be let out as soon as possible, for the consequences of not giving it exit may be very disastrous. Burrowing in the direction of least resistance, the matter may burst into the pleura, or pericardium; or the air-passages or blood-vessels in the neck may be involved in the destructive inflammation.

Method of opening.

The constitutional disturbance is generally very great, and the temperature chart will itself be evidence of the formation of pus. In cases of doubt, an exploring trocar may well be used, but when pus is known to be present, a more free opening than that effected by a needle is desirable. From anatomical considerations free use of the knife is dangerous, so that Hilton's method is peculiarly applicable to these abscesses. When the cavity is reached, the relief is usually immediate and very marked. The opening may be kept patent by a drainage tube, and the cavity syringed out in the usual way.

These abscesses must not be confounded with the common superficial cervical ones, which are often glandular, or peri-glandular. If they originate in glandular inflammation, attention should be directed to the head, where the source of irritation will generally be found in the shape of eczema or lice, or to the condition of the teeth, a common cause of cervical glandular trouble.

Tonsillar abscess, or quinsy.

Tonsillar Abscess, or Quinsy. An acute tonsillitis may result in the formation of pus. When it does, the distress and constitutional disturbance are very great. There is a very general disinclination to give relief here by incision, so that emetics are often given, partly in the hope that the abscess may burst, or, as it is phrased, "the quinsy may break," but also in the well-founded belief that unloading the stomach has in itself a beneficial action.

We have not here to consider the whole question of tonsillitis, but only the relief of tonsillar abscess, and we believe that the right course to pursue is to give vent to the pus by incision directly fluctuation is detected, while, on the other hand, in the absence of distinct indications, it is unwise to puncture the tonsil on the chance of matter being present.

Method of opening.

The operation is easy enough generally speaking, but sometimes is extremely difficult from the swelling of the parts, the difficulty in opening the mouth, etc. A spatula should be used to partly depress the tongue, and the patient should sit in a good light, with the head thrown back, and supported. A double edged "Paget's" knife should then be guarded by wrapping a strip of adhesive plaster round the blade, except for its last half inch, and with this precaution the bulging portion of the tonsil may quite safely be punctured.

Whether the quinsy burst of itself, or in the act of vomiting, or whether it be opened with a knife, the instantaneous relief which is afforded is very striking, so much so, that a patient who may be to all appearance in a critical, almost hopeless state, will in a very short time be in comparative comfort.

Alveolar abscess.

Alveolar Abscess—"gumboil." Here again relief should be given as soon as any elastic bulging indicates the presence of pus. A narrow-bladed scalpel should be used, and the incision, or puncture rather, should be close to the alveolus, and perpendicular to it.

Retro-pharyngeal abscess.

Retro-Pharyngeal Abscess. Niemeyer* quotes the dictum of his own teacher, Kruckenberg, that every physician should keep one of his finger-nails sharp and pointed, so that he might be ready to open immediately any retropharyngeal abscess he might run against. Though this was said in joke, no doubt the moral is earnest enough, that these abscesses should be opened as soon as they are recognised. They are almost always consequent upon caries of the cervical vertebræ, but the glands at the back of the pharynx are stated sometimes to be their origin. The abscess can be easily recognised on examination of the throat, when a bulging swelling, coming forwards between the pillars of the fauces will be seen. The dangers of leaving the abscess unopened are, that the swelling itself may produce dyspnœa, or that it may burst while the patient is asleep, and cause suffocation, or that the pus may track downwards into the pleura or pericardium, or involve other structures in the neck.

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* "Textbook of Practical Medicine," English translation, 1875, Vol. I., p. 459.

The opening itself is not difficult, and it is best effected by simple incision, which is always followed by great immediate relief, however unsatisfactory the after treatment of the case may prove to be.

Mammary abscesses.

Mammary Abscess.

This abscess is in the adult almost always a complication of lactation, and in all works of systematic surgery is divided into sub-mammary, intra-mammary, and supra-mammary. This classification fairly accords with clinical experience.

Supra mammary.

Cases of small superficial abscesses just beneath the skin, in the neighbourhood of the nipple, are very common during suckling, and generally heal well after they are opened by a small puncture.

Sub-mammary.

Again, every now and then we come across cases where pus is pent up beneath the breast close against the great pectoral muscle, lifting up the whole gland, and coming to the surface at its margin, often at two or more places.

A free opening and thorough drainage of the tissues underlying the breast, is the essential treatment of this last-mentioned condition. It will often happen that the natural pointing is at a spot in the upper half of the circle surrounding the breast, and in this place the first opening must be made, but if possible the abscess should be drained from a lower point, and it will generally be the best plan to pass a director downwards behind the gland until it can be felt protruding below. By cutting down upon its point there will be no difficulty in getting a drainage tube right through, and in emptying the abscess from the bottom, But more common than the sub-mammary abscess are the cases where the whole gland is infiltrated with inflammatory exudation, which easily breaks down into pus, so that day after day fresh foci of suppuration are discovered, and have to be opened, in the substance of the gland. With regard to the opening, the only rule to bear in mind is that the incisions should be made in a direction radiating from the nipple, so as to divide as few milk ducts as possible. Here again, every effort must be made to empty the abscesses from the bottom, or as low down as can be managed; drainage tubes should be freely used, and the cavities thoroughly washed out.* The breast must be carefully supported with a triangular, or roller bandage. If it be desirable to apply a moderate amount of pressure, this is best done with a Martin's bandage, which may be put on so as to raise the breast, and gently compress it at the same time. Intra-mammary.

Thecal Abscess, or Whitlow, is a very common, and a very destructive form of abscess, often permanently crippling or injuring the fingers, or the hand. It arises from a fouled or poisoned wound, or sometimes, it would seem, idiopathically. Whitlow.

We have here to do with pus shut up in a tunnel with a thick roof, closed at one end (at the fingers) and open into the palm, but not freely, so that there is always great tension, and corresponding constitutional disturbance, while the acuteness of the inflammation may cause necrosis, especially of the ungual phalanx, destruction of the phalangeal joints, sloughing of the tendons, etc.

It is therefore very important to open whitlows early and thoroughly, going fairly into the sheath of the tendons, and if necessary, down to the bone. The principal incision will almost always have to be made in the middle line in front, but others will often be required. Care should be taken to avoid the arteries which run along the sides of the fingers. Early opening important.

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* A form of abscess in connection with the female breast we ought not to omit to mention, although it may be hoped that its occurrence is unknown outside the sphere of the mischievous activity of the midwives who minister to the London poor. Among the many dangers which a London baby girl has to run on being launched into the world, is that of having its "breast strings broken," which means that the fascial connections of the gland (which at birth is physiologically rather active) to the underlying parts, are forcibly stretched or torn, with the frequent result that an acute inflammation, often running on to suppuration, is set up. We have seen several deaths caused in this way.

In addition to opening the thecal abscess, incisions will be often called for to relieve œdematous tension, or perhaps to let out pus in the palm, or over the back of the hand, as is required in phlegmonous erysipelas (*q.v.*). Indeed, there is good reason for holding that this form of inflammation is in many instances a local example of true erysipelas.

Chronic psoas abscess.

Chronic Psoas Abscesses or other collections of pus originating from spinal caries, and chronic abscesses in the neighbourhood of joints, may often be left alone for an indefinite time. When it is decided to give exit to the pus, this is very generally done in the first instance by the aspirator, and no limit can be assigned to the number of times the sac may be thus emptied, if the matter re-accumulates. But in most cases, sooner or later, these abscesses will have to be more freely opened and drained, and counter openings will be required. This free opening is always performed with all antiseptic precautions, and it is most important to get them drained from the most dependent part possible. If they lie very deep, "Hilton's method" may be used.

Abscess or cyst in the liver or kidney.

The free opening of abscesses in connection with the *liver or the kidneys* belongs to the class of major surgical operations, but the house surgeon may be called upon to aspirate, or to tap with a trocar and cannula, fluctuating swellings in connection with either of these organs, whether they be abscesses or hydatid cysts. It will here often be wise first to explore the swelling with a hypodermic syringe, if it be at all within reach by these means. In inserting the aspirating needle or trocar, the anatomy of the parts must be very carefully considered, and the exact depth to which the point is to reach determined. If the cavity be large, the fluid should be drawn off very slowly to diminish the risks of bleeding into the sac.

Manson's method.

Dr. Manson, of Hong Kong, has recommended that such abscesses should be punctured with an ordinary trocar and cannula, and that the india-rubber drainage tubing should be introduced *while it is on the stretch*. This is effected by a stylet and a thread, so that when the thread is cut, the tube as it retracts, thickens and plugs the cavity in the organ and the parietes, while it yet allows of free drainage.

Acute periostitis.

The next deep-seated collection of pus we have to consider has to be treated very differently, for cases of *suppuration beneath the periosteum*, or indeed of periostitis threatening suppuration, require more urgently perhaps than any other collection of pus, *early* and *very free* incision. In *acute* *periostitis* (acute diffuse osteitis and periostitis, acute necrosis, or suppurative periostitis) we have a condition in which it is hardly paradoxical to say that the pus should, if possible, be removed before it is formed. No time should be lost in relieving the strangulating tension of the inflamed membrane by free incision right down to the bone. Unfortunately the inflammation is deep, and fluctuation may be hard to detect, so that it only too often happens that the case is called one of "very bad rheumatism," until the pus has stripped off the periosteum, up and down the limb, and the bone is doomed to die, although by taking action a few hours earlier, it might have been saved. But, although fluctuation may be obscure, this inflammation is really quite unlike any less serious form; the swollen limb, the skin shining from tension, and white from the same cause, the peculiar hard œdema and exquisite tenderness, and the depth at which the fluctuation can be felt, if felt at all, are all signs which should be distinctive enough.

Use of free incisions.

There is only one line of treatment, namely, to make a free incision, or more than one if requisite, right down to the bone. In many cases the knife will strike against hard dead bone, and in any case the relief afforded by the exit of the pent up pus will be very great. The cavity must be well syringed out, and in all respects treated like an acute abscess, until the time comes for the consideration by the visiting surgeon of operative measures for the removal of the necrosed shaft in its entirety, or of a portion of it detached by the process of carious necrosis.

Suppurating bursa patellæ.

Another very acute form of abscess which calls for early relief is a *suppurating bursa patellæ*. Of the treatment of the common housemaid's knee we will say something presently, but instances are not at all rare of a suppurative inflammation of this bursa, which may, or may not, have been previously enlarged. The results of neglecting to incise this acute abscess as soon as it is recognised, are comparable to, and indeed may be even more serious than in the case of a whitlow. The patella may necrose in part, or altogether; or worse still, the knee joint may become involved, if the pus fails to make its way to the surface. On the other hand, an incision made into the acutely inflamed bursa some little time before suppuration has actually occurred, can do no harm, may very possibly prevent matter being formed at all, and will certainly give present relief.

On all accounts therefore, abscess or commencing abscess of the bursa patellæ requires an incision which must be free and in the middle line, and which must fairly open up the bursa.

The patient must, of course, be confined to bed, and the leg will be most comfortable when placed on a slightly bent MacIntyre, or on a back splint with a little extra padding beneath the hollow of the knee. A fomentation will be the best dressing, and recovery is usually very speedy.

The two last especial kinds of abscess which we shall consider, namely *buboes*, and *ischio-rectal abscesses*, have many features in common besides their proximity one to another. Both owe many of their peculiarities to the sort of tissue in which they form; both are apt to be followed by undermining fistulæ or sinuses.

Buboes. The term "*bubo*" is applied to all glandular or peri-glandular abscesses which occur in consequence of inflammation set up in, or around, the femoral and inguinal glands. The exciting causes are very various. In scrofulous children, the irritation of eczema intertrigo, or of ascarides, or phimosis, may cause the inguinal glands to break down, while a sore heel or inflamed scratch on the leg may produce the same result in the femoral group.

In adults, similar injuries of the leg but rarely produce a femoral bubo, while (also somewhat rarely) herpetic eruptions about the corona glandis, the irritation of piles, or of condylomata about the anus, may be the cause of suppuration about or in the inguinal glands. But, in adults, the most frequent causes of buboes are, gonorrhœa, soft sores (chancroid), or more rarely, infecting sores; these buboes are almost always abscesses *around* the glands, which run a subacute, burrowing course (they may, however, take on a phagedænic action in patients with broken down constitutions).

Buboes should always be opened early, from the tendency they have to form long fistulous tracks in the cellular tissues. A vertical incision should be made with a straight scalpel or a Syme's knife, and the abscess cavity kept open, so that it may heal from the bottom. This may conveniently be done by packing it with a strip of oiled lint.

The cut is made vertically,* in order to avoid wounding the superficial arteries in this region. These are, however, often enough divided, but the bleeding can always be arrested by plugging, pressure and a firm spica bandage

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* The scars of these cuts are always seen to be parallel to Poupart's ligament, through a later change in the position of the wounds. This often causes perplexity to the young dresser.

(Fig. 52). If fistulous tracks remain, they will have to be laid open and treated in the manner to be presently described.

Ischio-rectal abscess.

Ischio-rectal Abscesses, i.e., those which form in the loose fat about the lower part of the rectum and the anus, occur generally in people of feeble health, and especially when there is chronic portal obstruction. They and their results, *fistulæ*, are also especially common in phthisical subjects. In many cases, no doubt, they are idiopathic in their origin, but often their starting-point may be traced to a fish-bone, or a small splinter of bone, or of some other foreign body, which has perforated the lower part of the gut.

These abscesses form very quickly, and soon come near to the surface. It is extremely important to open them freely as soon as they are detected, and not to allow them to close up again. Even with every care and attention, in a great many cases a sinus will be left, running up to, or perforating, the walls of the rectum, and which will not heal unless it be laid open (see fistulæ). The pus which is evacuated is always very fœtid, and the abscess cavity should be well syringed out with carbolic lotion, and then lightly plugged with a strip of lint soaked in carbolic oil, eucalyptus oil, or some such cleanly dressing.

Abscess of antrum.

Abscess of the antrum (so called). This is rather an accumulation of purulent fluid in the cavity of the antrum, than an abscess, strictly speaking, and collections of cystic fluid here have very often been mistaken for abscesses. The excessive collection is generally due to inflammation about the fang of the first, or more rarely, of the second molar tooth, which penetrates the cavity; or it may be an extension of an alveolar abscess in connection with one of these. So long as the antrum communicates with the nose there are no acute symptoms, but when the aperture is obstructed, the constitutional symptoms of suppuration are developed, with pain, swelling, and a peculiar parchment-like thinning of the antral walls towards the cheek, and in the roof of the mouth.

If the first or second molar be carious, the best way of emptying the antrum is to extract the tooth, and if the pus does not discharge through the socket, to perforate this with a small trocar. But if the teeth are sound, and there is an obvious bulge in the thinned wall above the alveolus, between it and the cheek, or a similar condition in the roof of the mouth, a trocar, or a scalpel should be thrust through into the cavity.

After the fluid has been evacuated, a small drain (such as may be made out of a twisted-up strip of gutta-percha tissue), should be inserted, and the cavity syringed out with a strong carbolic acid solution. The fluid is often very fœtid, and the washing may have to be repeated for some days.*

One accident must be especially guarded against in pushing a trocar into the antrum, namely, that the floor of the orbit be not wounded; to prevent the chance of this, the depth to which the trocar should penetrate must be limited by the finger placed upon it.

We will not here consider abscesses such as those of the mastoid cells, or of the middle ear, which are difficult of diagnosis, or require such special knowledge or responsibility in their treatment, as to take them out of the category of minor surgery.

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* See upon this point an article by Mr. Morton Smale in the *British Medical Journal*, 1885, Vol. I., p. 750.

CHAPTER XXXIV.

OF THE EVACUATION OF THE SYNOVIAL SACS OF JOINTS, AND OF BURSAL AND SEROUS CAVITIES.

Of distension of joint cavities.

JOINT cavities may become distended with fluid, either through acute or chronic inflammatory effusion, which may be serous or purulent; or more rarely, from hæmorrhage, as in the case of fractured patella, or from some much slighter injury in patients with a constitutional tendency to hæmorrhage, and in some of these cases it may be advisable or imperative to relieve the tension within the joint.

Joint effusions will come under some one of the following heads:—

Acute inflammatory effusion—non-purulent—(traumatic, or idiopathic).

Acute suppuration within the joint—(abscess of joint).

Chronic effusion—(hydrops articuli, or joint dropsy).

Hæmorrhage—always accompanied by more or less inflammatory effusion; may be traumatic, or a symptom of the hæmorrhagic diathesis.

Acute inflammatory distension.

Idiopathic.

(1.) *Acute inflammatory effusion, non-purulent.* It is very rarely indeed that an idiopathic synovitis causes distension to such an extent that the fluid has to be removed. Rest, cold, or leeches, will almost always sufficiently reduce it. But if this mode of relief be decided upon, it must be effected with a fine aspirating needle, and it is best to remove only sufficient fluid to lower the tension, without endeavouring to empty the sac, in which attempt the joint structures might be further injured. In aspirating joint cavities, the needle must always be extremely sharp, and perfectly clean.

Traumatic.

But in cases of effusion, arising in consequence of injury, it somewhat more frequently occurs that the internal tension is so great, that it is right to prevent permanent damage through the softening of the ligamentous structures about the joint, by removing the fluid. This is always done by aspiration, as above mentioned.

Hydrops articuli.

In rare cases of chronic effusion into a joint, where the quantity of fluid is large, the signs of inflammation absent, and when the ordinary measures for producing absorption have failed; recourse has been had to aspiration, followed by pressure, or to tapping, and then injecting some stimulating fluid, as the tincture of iodine, freely diluted. There is no difficulty in the performance of this operation, but it is not one that should be lightly undertaken, nor until all other measures have failed, and the usefulness of the joint is greatly impaired.

Hæmorrhage and effusion.

In cases of very severe injury to a joint, as, for example, that which is inflicted on the knee joint in some cases of fracture of the patella, the joint may become greatly distended with blood as well as with inflammatory effusion, and the tension here also may be so great as to call for aspiration, as was mentioned when we were considering that fracture. If it be adopted, a somewhat larger cannula or needle will be required than for the removal of simple serum.

Patients who are examples of the hæmorrhagic diathesis, either in the shape of hæmophilia or purpura, or who are attacked with scurvy,* may have almost spontaneous effusion of blood into their joint cavities. In these cases no operative interference is ever called for, and the effusion must be left to be re-absorbed by natural means.

Abscess within joints.

But when in acute arthritis the local and constitutional signs point to the presence of *pus* in a joint, the line of treatment differs in almost every particular from those we have been discussing. Now, every hour's delay in affording relief is dangerous, and the question lies between aspiration, tapping with a large trocar, and laying open the joint freely.

The reason for using an aspirator is that there is still sometimes a doubt as to the nature of the fluid within the joint. If it be slightly turbid serum, it is just possible that suppuration may be avoided, but if it be pus, the joint will certainly have to be freely opened sooner or later, and we fail to see the advantage of repeating the preliminary aspirations. Tapping with an ordinary trocar is attended by more risk of damaging the joint cavity, but in the case of turbid synovia it is sometimes necessary to use this instrument, as the thick fluid may not be able to flow through an aspirating needle.

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* The reader may be here reminded of the instances of a similar condition, namely of spontaneous hæmorrhage, apparently occurring in rickets, or in rickets plus scurvy, which have been recently brought forward by Messrs. Owen, Page, etc.

If a joint is to be freely opened, this must be done by such incisions as will secure drainage and a free passage for lotions, etc. The general practice is to use antiseptic dressings, even when there are distinct constitutional signs of septic fever. In all cases the joint must be kept most carefully splinted, and great attention must be given to its position. As a rule, the joint cavity, and the abscesses which are apt to form in its neighbourhood will have to be washed out very frequently.

Suppuration inside a joint also occurs in the later stages of chronic arthritis, and will often call for relief by incision; hardly ever by aspiration. The necessity for relief is not in these cases so urgent, but in all other respects their management is similar, although the prognosis is much less hopeful.

Of aspiration and incision of the knee joint.

We have hitherto considered the question of evacuation of joint cavities, as applying to all joints, but it is the knee which is especially apt to become acutely inflamed, or dropsical, or in which there is found blood, or acute suppuration. We must therefore consider particularly the exact methods of aspiration and incision of the knee, although we need not do so in the case of any other articulation.

The spot where the synovial membrane of the knee joint comes nearest to the surface, is on the inner side, at the level of the lower border of the patella, and the aspirating needle should there be plunged into the place where the fluctuation seems to be most distinct, entering the cavity of the joint at right angles to the skin surface. Gentle pressure should be made upon the part as long as any fluid escapes, and when the cannula is withdrawn, a very small pad of lint soaked in collodion may be placed on the spot, as a precautionary measure. If the needle be one of the fine ones generally used in aspiration, this pad is hardly necessary, but if a larger trocar and cannula be used, it should never be omitted.

Incision of the knee joint.

In incision of this joint if one opening only be made, this will almost always be on the inner side; but as a rule, a counter opening is also deemed advisable, to secure thorough drainage, and the readiest way to get into the joint on the outer side is to make the inner incision first, and then to pass a probe or director across the interior of the cavity until it can be felt beneath the skin, and can there be cut down upon.

Housemaid's knee.

Of acute abscess of the bursa patellæ we have already spoken, but it frequently happens that this bursa, as well as others, is the subject of chronic enlargement, from accumulation of fluid within. In some cases this may be re-absorbed by the action of iodine, blisters, etc., or by steady compression, or strapping. But very frequently it will be necessary to evacuate the glairy or gelatinous contents of these sacs. The best way to do this is to slip a sharp double-edged Paget's, or tenotomy knife into the interior, drawing the skin over the underlying sac somewhat to one side, so that a valvular opening is made, and keeping up pressure with the fingers till the contents are squeezed out. When the sac is emptied, firm compression with a pad and bandage must be maintained, and it will generally be wise to restrain the movement of the part by means of a splint. Thus in the case of an enlarged bursa patellæ, or "housemaid's knee," a back splint for the knee joint should be applied.*

In cases where the bursal wall is very much thickened, it is usually necessary to dissect out the bursa; this should be done through a vertical incision, and the knife kept close to the bursal wall, in order to avoid wounding the knee joint.

Simple ganglia.

Simple ganglia, similarly, are saccules filled with a material like white of egg, which form in connection with the synovial sheaths of tendons, usually of the extensor tendons of the fingers, as they course over the back of the wrist. It will often be found that firm pressure will succeed in rupturing the ganglion subcutaneously, so that its contents are pressed into the surrounding tissues, whence they may be absorbed. In this case, after they have thus been burst, a pad and bandage for a few days is all that will be required.

But if they do not break readily, the best plan is that just described for bursæ, namely, to slip a narrow bladed knife into them through a valvular incision, to press out their contents, and then to apply pressure, and a light splint.

Compound ganglia.

Compound ganglia, such as those which often extend beneath the annular ligament at the wrist, are much more serious, and frequently contain melon-seed bodies. The best way to treat them is by vertical incisions above and below the annular ligament whereby the cavity can be thoroughly irrigated. It is usually well to drain for a couple of days, the hand and arm being kept on a splint.

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* See on this question a paper by Mr. Savory, in the "St. Bartholomew's Hospital Reports" for 1865.

Of the evacuation of serous cavities.

Of the evacuation of serous cavities.

The serous cavities of the pleura, peritoneum, and the tunica vaginalis testis are frequently the seat of fluid accumulations which have to be removed by aspiration, tapping, or incision, and the methods of the evacuation in each case must be considered separately.

Paracentesis thoracis.

Paracentesis Thoracis is a simple enough operation, if the physical signs of the presence of fluid are distinct, but if there be any doubt on that point, or if the pleura has to be punctured in an unusual place, it will be safer first to insert a fine exploring aspirating needle, the most convenient instrument being an ordinary hypodermic syringe.

By aspiration.

Aspiration is generally the method chosen when the fluid is believed to be serum, or when the pleural cavity is to be emptied for the first time. The ordinary pattern of the instrument is shown in Fig. 195, and its management has been described. The place of selection for the insertion of the needle, and for all other punctures and incisions into the pleura, is either in the axillary line in the middle of the fifth, or of the sixth interspace, or if an opening further back be required in the seventh or eighth interspace, about three inches behind the axillary line.

Mode of insertion of needle.

The needle or fine trocar must be very sharp, and must be inserted with a "stab" so as to avoid pushing forward any false membrane adhering to the parietal pleura. The patient should lie as low as the performance of the operation will allow, and if faintness should come on, the evacuation should be stopped for a time.

By a trocar and cannula.

The aspirator has displaced the old trocar and cannula to a great extent, but the latter instrument is still frequently employed. It is desirable, when a trocar is used, to have some arrangement by means of which air shall be excluded

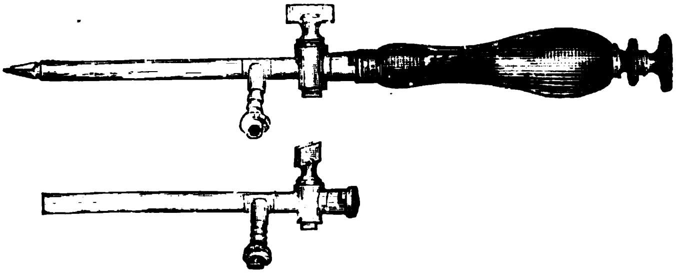

FIG. 196.—*Thomson's Piston Trocar with Side Branch.*

from the chest cavity during the operation. The usual method is to attach to the side branch of Thomson's piston trocar (Fig. 196) a piece of indiarubber tubing, long enough for its lower end to be below the surface of some 1 in 20 carbolic contained in a vessel placed upon the floor.

The tube having been attached, the trocar is inserted as the aspirating needle was, and the cutting piston is immediately withdrawn into the handle, so that the fluid passes down the side branch and down the tube, which acts as a syphon.

It will be understood, too, that with this trocar it is possible to wash out the chest if this be desired, as in empyema. For this purpose a funnel should be attached to the end of the tube, and the fluid used for the washing out (Condy, iodine lotion, etc.) will flow into the chest if it be poured into the funnel, when it is raised above the level of the patient, and will flow out again when it is depressed beneath the level. (This washing out, however, is far better performed when the third method, *i.e.*, that by incision, is the one adopted.)

It will often happen that the aspirator or trocar will draw off healthy serum, and that the operation will not need to be repeated, or at least only once or twice, the fluid remaining serous throughout. But if the evacuation has to be often repeated, pus is almost certain to be formed, while in other cases it may be present from the first.

We have now to do with an empyema instead of with a pleurisy with effusion; and although this condition may be successfully treated without any further steps than aspiration, or tapping, it will, as a rule, become necessary to have a more free and more permanent opening, or openings; that is, the usual operation for empyema must be performed.

Incision for empyema.

This operation should be carried out with all antiseptic precautions, especially if the pus be at the time quite sweet. An anæsthetic will generally be necessary, but it must be given with caution.

If one incision alone is to be made, it should be as far back and as low down as possible, in the seventh or eighth interspace, as before mentioned. A free incision may be made through the skin, 1½ to 2 inches long, along the middle of the space, and then the muscles must be divided until the pleura is reached. Then with a steel director, no difficulty will be found in scratching through into the pleural sac, when a gush of pus will take place. The opening may then be enlarged with a pair of dressing forceps.

When the excess of pus has come away, a full-sized drainage tube, about three inches long, should be inserted, care being taken that it can by no possibility slip inside.* A light antiseptic gauze dressing, with plenty of loose gauze or marine tow to absorb the pus must lastly be applied.

Counter openings.

A still more efficient drainage is provided if the method of a counter opening be adopted. This may be conveniently made in the usual place for paracentesis, and the simplest way is to make the upper incision into the pleura first, in the same manner as the lower one just described. This done, a long somewhat curved silver probe can be passed downwards and backwards, till its point is felt between the lower ribs behind, where it may be cut down upon. Separate upper and lower drainage tubes may be used, but it is generally better to pass one tube having numerous side holes, right through from the one opening to the other.

So long as the pus remains sweet, washing out is hardly necessary; but these empyemas frequently become very foul. There is, however, no difficulty in thoroughly washing out with some disinfectant fluid, such as Condy, sanitas, or iodine, etc.

Whatever plan of dressing be adopted, the material into which the purulent discharge drains through the tube must be absorbent and antiseptic. Sal alembroth wool, wood wool pads, salicylic wool, carbolised tow, or oakum, are the most commonly used, but there are many others. Care, too, must be taken that the tube does not become blocked by being bent over on itself.

Paracentesis abdominis.

Paracentesis Abdominis is a more simple operation than that for the evacuation of the pleural cavity. The spot chosen is almost always midway between the umbilicus and the pubes, and exactly in the middle line. Before tapping, the bladder should be emptied, if necessary with a catheter. The patient should be placed half sitting up in bed, and a very broad flannel bandage, or some form of binder, must be so adjusted that it can be tightened up from time to time, to give support to the abdominal walls and contents, as the fluid is removed.

By a trocar and cannula.

A simple full-sized trocar and cannula may be used, but a much more convenient pattern is the "piston trocar," with a side branch for a tube, as has been described for the chest,

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* To prevent this accident a shielded drainage tube, which we have found very useful, is made by Messrs. C. Wright and Sons, after the directions of Mr. John Shaw.

Fig. 196, but a good deal larger than is requisite for the purpose of paracentesis thoracis. It often saves pain to make a small incision through the skin, before plunging in the trocar. The direction of the puncture should be backwards, and slightly downwards, for as the abdomen diminishes in size, the trocar will alter its position, tending to point more and more upwards and away from the fluid.

The fluid should be received into a bucket placed on the floor by the side of the bed, and, as we have said, the abdominal walls must be carefully supported throughout the operation. The patient must be watched, lest faintness should come on, and will often require a little stimulant. If necessary the flow of the ascitic fluid may be stopped by raising the tube above the level of the abdomen till the faintness passes off.

By a Southey's trocar. Another way of draining off ascitic fluid is to employ one of Dr. Southey's trocars (Fig. 197). These trocars with their ensheathing cannulæ are made as fine as possible, and can be connected with a specially fine kind of drainage tube. The insertion of these small instruments is practically painless, and is performed in the same place and direction as the larger ones. The trocar and cannula may be inserted, and the trocar withdrawn after the usual manner of using this instrument; the tubing being then slipped over the protruding end. But as the end and the tube are both small, it is sometimes a little difficult to do this. A side branch has been suggested as an improvement in this respect, but this is not at all necessary, for the difficulty is quite overcome if the tube be attached beforehand to the empty cannula, and the trocar be then thrust into it, piercing the tube first,

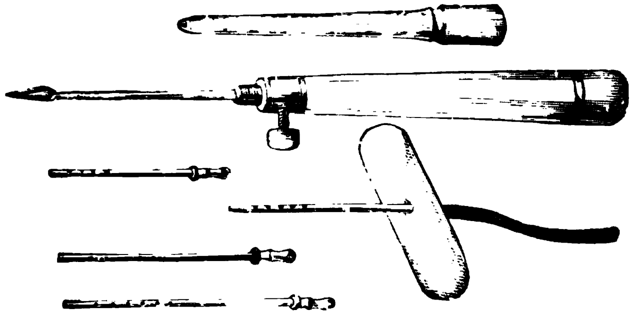

FIG. 197.—*Southey's Fine Trocars and Cannulæ.*

at a very little distance from its end. When the trocar and cannula have been inserted in the tissues, and the trocar is withdrawn, it will be found that the small puncture which has been made in the indiarubber tube closes of itself. The tube is said to deliver the fluid at a rate of from ten to twenty ounces per hour, so that there is no sudden disturbance of the visceral relations, and no necessity for swathing the abdomen in any form of binder.*

Anasarca or serous effusion into the cellular tissues.

These trocars were originally introduced by Dr. Southey for a different purpose, namely, for the relief of severe and tense anasarca — a condition which may here be conveniently considered. In the great majority of cases of serous effusion into the cellular tissues, elevation, and the removal of all obstruction to the venous circulation will be all that is required, and if the œdema be more obstinate than usual, it may be diminished by bandaging, and especially by the use of Martin's rubber bandage. But sometimes the distension of the parts is so great that the skin is stretched even to bursting, and a peculiar form of superficial gangrene, combined with a condition of erysipelas is apt to develop.

Under these circumstances it becomes necessary to relieve the tension by removal of the fluid, and this was commonly done by making numerous stabs or minute incisions with a small scalpel from which the serum could drain away. The objections to this proceeding were that the limbs affected (usually the legs) were forced to remain wrapped up in sloppy clothes, and that the skin, bathed in the exuded serum, soon became sodden. Moreover, it not infrequently happened that the punctures themselves became the starting points of troublesome sores or erysipelas.

These objections are all met by the use of the fine cannulæ † above mentioned. Three or four of these may be introduced into the dropsical parts by means of the trocar, and then the serum which escapes through them may be conducted away from the bedclothes by the indiarubber tubing.

The tubes should be of sufficient length to discharge the fluid into some vessel below the bed.

The cannulæ should be introduced at right angles to the surface, and should fairly enter the cellular tissue. Great care must be taken to keep the instruments scrupulously clean, and they should always be placed in a 1 in 20 carbolic solution before they are used.

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* *Lancet*, August 10th, 1878.
† *Lancet*, May 5th, 1877.

Treatment of hydrocele of the tunica vaginalis.

The treatment of hydrocele of the tunica vaginalis may either be palliative, remedial, or curative. Thus, it often occurs that a moderate-sized hydrocele may remain stationary for years, giving little or no trouble, provided only that the scrotum is properly supported by a suspensory bandage.

But in most cases, the serous effusion will sooner or later accumulate to an extent which produces discomfort or pain, and very frequently the sac takes only a short time (that is, one to be measured by weeks) to fill. The remedy in these cases is to remove the fluid by tapping, whenever and as often as it causes inconvenience by distension. Although it very rarely happens that the fluid does not re accumulate, still most patients are thus enabled to escape any real disablement.

Right time to tap hydrocele.

In deciding whether the right time has come to tap a hydrocele, attention should be given rather to the tenseness of the sac, than to its size. It is always wise to wait until it is fairly full, not only because the operation is then easier, but because the intervals between the tappings should be as long as possible.

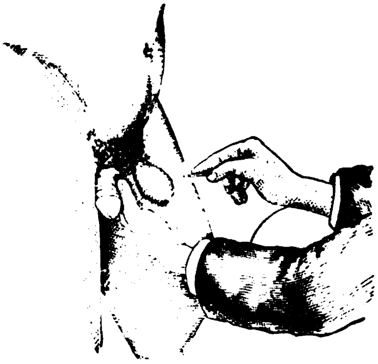

FIG. 198.—*Tapping a Hydrocele (right way).*

No surgical operation would seem to be easier than tapping a hydrocele, and in truth it is as easy as it seems to be. Yet even here there is a right and a wrong way, and the wrong is often chosen.

Method of tapping.

The points to be looked to are, that the testicle be protected from injury, that the skin of the scrotum and the sac be made tense and prominent in front, and that the cavity be entered with one stab of the trocar, the veins of the scrotum being avoided, and the depth of the plunge being regulated beforehand, by the position of the finger on the trocar.

The right way.

Most of these points are shown in Fig, 198, where the left hand is seen to be making the tissues tense in front, and at the same time receiving and protecting the testis behind, while the forefinger of the right hand steadies the trocar, and serves as a shield, so that it cannot be pushed in too far.

The wrong way.

In Fig. 199, on the contrary, some of the common faults committed in tapping are illustrated, such as the oblique position of the trocar (which may never enter the sac at all), the left hand pushing the testis downwards and forwards, etc.

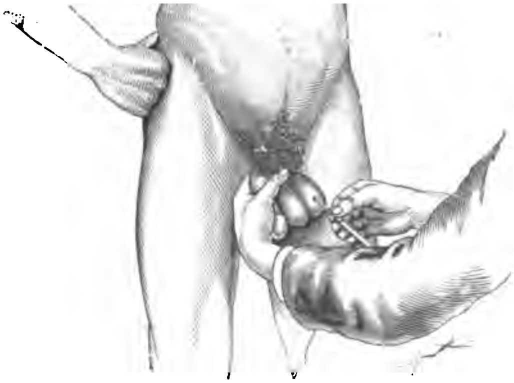

FIG. 199.—*Tapping a Hydrocele (wrong way).*

The trocar commonly employed is shown, half size, in Fig. 200, but smaller ones, down to a fine exploring trocar, may well be used. When all the fluid that will escape has been drawn off, the cannula must be withdrawn, and unless a needlessly large instrument has been used, there will be

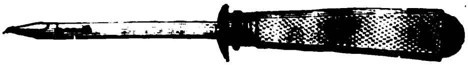

FIG. 200.—*Hydrocele Trocar.*

no necessity for considering the wound. A suspensory bandage should be worn from the first.

So far as the tapping is concerned, the directions given above for the ordinary hydrocele will apply almost equally to any of the various cystic accumulations which are common here (such as hydrocele of the cord, spermatocele, etc.), and we need not consider them further.

Radical cure of hydrocele.

As has been said, the tendency of hydrocele is to recur after tapping, and the object of what is known as its *radical cure* is to produce such an inflammation of the serous lining of the tunica vaginalis, as shall produce an alteration of its secreting power, while still being within the limits of safety.

The fluids for injection.

The common method of doing this is to inject into the serous sac, some irritant fluid, but although at the time of the introduction of this treatment others were employed, such as port wine, in practice almost the only ones now used are the pharmacopœial and the "Edinburgh" tinctures of iodine, the latter being a good deal the stronger preparation.

The operation.

If the P. B. tincture be used, the usual method is as follows:—The hydrocele is punctured and the fluid drawn off, especial care being taken that the cannula is well within the serous cavity. This cannula fits over a syringe with a metal nozzle, made for the purpose, and containing about half an ounce of the tincture. This is then very slowly injected, the syringe disconnected, and the aperture in the cannula closed with the finger, or with a splinter of wood. The scrotum is afterwards so manipulated for about a minute, that the iodine is made to come in contact with every part of its interior, and then about half the quantity which was injected is allowed to escape.

During the whole operation it is best for the patient to stand (unless he be likely to have an emotional faintness), and when it is finished he should go to bed. There may be some nauseating pain at the time of injection, but as a rule this comes on about three or four hours later, and should continue, with other signs of inflammation, for about a week.

As soon as the parts can bear it, it is often wise to strap the scrotum, and in any case the patient should wear a suspensory bandage as soon as he begins to get about. The whole treatment lasts about three weeks. Failure more frequently comes from too little action being set up, than from too much, and if, after a few hours, there is an absence of more than a moderate amount of heat and tenderness, the scrotum should again be freely handled and the patient made to walk about.

Sloughing, or diffuse cellulitis is very rare, and when present is generally due to an escape of the iodine into the scrotal tissues, through malposition of the cannula.

If the stronger or Edinburgh tincture be used, the common practice is to use 2 drachms only, and not to withdraw any of it after injection; this plan may also be followed with the English preparation.

Other methods.

There are some other methods of radical cure of hydrocele which may be mentioned. They are generally not employed until the injection method has failed.

I. A small quantity of silver nitrate may be fused upon a silver probe, and applied to the interior of the sac, after it has been tapped, by passing the probe through the cannula which has been used to draw off the fluid. The serous lining should be lightly "scored" by the caustic.

II. The sac may be incised antiseptically, and a drainage tube inserted for a few days; or it may be freely opened, and then plugged, not very tightly, with a strip of carbolised lint, and the edges of the incision brought together again with sutures, except at the most dependent part, where a little of the lint hangs out for drainage. The scrotum is then covered with salicylic wool and supported. The plug may be removed in a couple of days.*

III. When all other methods of treatment have failed, the tunica vaginalis may be carefully dissected out.

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* See note by Mr. Bellamy, *Lancet*, 1885, Vol. II., p. 12.

CHAPTER XXXV.

OF THE USE OF CATHETERS—ASPIRATION AND TAPPING OF THE BLADDER—OF THE USE OF THE STOMACH PUMP, ETC.

IN this chapter we shall consider, first, the chief practical points which arise in connection with the passage of instruments along the urethra into the bladder; next, the methods of emptying the bladder of its contents by aspiration or by tapping, and of washing out the bladder. We shall then pass on to describe methods of washing out the stomach by the stomach pump, and by other means; the introduction of food into the stomach artificially; the administration of enemata; and, lastly, the performance of hypodermic injection.

Uses of catheters.

Of the objects of Catheterisation, or the passage of Bougies, Sounds, etc.

The passage of a catheter may be required for the relief of *retention*, whether arising from spasm, stricture, or enlarged prostate, or from an atonic, or paralytic state of the bladder walls; or from a combination of some of these causes. It may also be necessary, both for the prevention of extravasation, and the relief of retention in cases of injury to the urethra (and sometimes in rupture of the bladder), and later, for the prevention of traumatic stricture.

Of bougies.

Catheters or bougies are also employed for the *cure* of strictures by mechanical dilatation, and both the metal instruments, and what are known as *medicated bougies*, are employed in disorders of the urethral mucous membrane, such as gonorrhœa. Again, catheters are used for the systematic emptying of the bladder, and for the introduction of lotions ("washing out" the bladder) to improve the condition of its mucous membrane; and ones of a very large size are employed to remove calculous *débris* after lithotrity, and more rarely, blood-clots.

Lastly, catheters or bougies are frequently used as guides to the position of the urethra, or of strictures within it, in various operations.

Of sounds, staffs, etc.

Sounds, on the contrary, are used purely for diagnostic purposes; while *staffs* are directors of various shapes and curves, which possess a deep groove, along which a cutting instrument may be passed for the incision of a urethral stricture, or for entrance to the bladder. There are, moreover, many other instruments, such as internal urethrotomes, urethral dilators, galvanic bougies, etc., the purposes of which may be known from their names. With the majority of urethral instruments we have here nothing to do, and as we have already considered conditions such as the retention of urine, and the immediate treatment of rupture of the urethra, we have here only to treat of the actual manipulative proceedings which are necessary for the skilful passage of catheters, bougies, etc.

Different kinds of catheters.

Of the different kinds of Catheters.

The English gauge.

The ordinary silver or plated catheters are too well known to require description. They, as well as the flexible ones, are made in England and America in sizes from $\frac{1}{2}$, up to 12 or 15, or even larger, according to an arbitrary gauge (Fig. 201). In France a more systematic plan is followed, the numbers of the instruments corresponding to their circumference in millimetres, No. 1 being 1 mill. round, No. 5, 5 mill., and so on. This principle gives more numerous sub-divisions; thus there are 18 numbers (3 to 21) between the 12 ordinary English ones (1 to 12).

The French gauge.

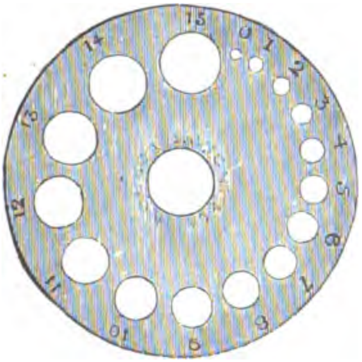

FIG. 201.—*English Catheter Gauge.*

Prostatic catheters.

With regard to the curve, the standard one is commonly called "Brodie's," but many surgeons prefer to have their instruments curved according to their own ideas. Prostatic metal catheters, to which we shall again refer, are also generally named after Brodie. They differ from the ordinary ones in being both longer and much more boldly curved. The curve, too, should extend quite to their extremity, which is not always the case with the others (Figs. 202, 203).

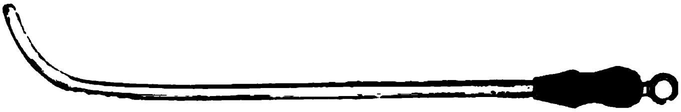

FIG. 202.—*Ordinary Silver Catheter.*

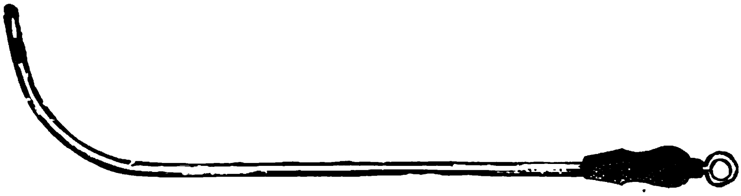

FIG. 203.—*Prostatic Silver Catheter.*

Metal bougies or solid instruments are not now very commonly used. They are of the same shape and gauge as catheters.

Lister's bougies. Lister's bougies, however, will often be found of great service in dilating a stricture; they differ from the ordinary bougies in that they taper towards the point, which is three sizes smaller than the shaft. The passage of the point through the stricture, ensures therefore the passage of the shaft of the bougie, and each instrument in this manner prepares the way for the larger size which is to follow.

A very useful instrument in cases where the urethra is tortuous, is a flexible metal bougie, made of pewter or of some similar alloy.

Flexible catheters. Of *flexible catheters* there are several kinds, but the principal ones are made of "gum elastic" and of india-rubber. Celluloid has also recently been used. Gum elastic catheters are made of some preparation of gum resins, incorporated into the meshes of a woven tube, which should in all cases be made of silk, although linen thread is often used.

Gum elastic, two kinds. There are two chief kinds of these gum elastic catheters, each made in several qualities. In the older kind, the woven basis is stiffened by gum resins, and varnished, so that the instrument is yellowish red and shows the meshes of the silk or thread. These catheters are flexible when heated, but tolerably stiff when cold. A wire stylet of the ordinary catheter curve, or of any other which may be desired, is generally placed in their interior, the shape of which they will retain after it is withdrawn, even when rendered moderately flexible by warming. With regard to shape, this kind is always uniformly cylindrical, like the silver catheters.

The other kind is now in much more general use, and many forms of catheters, differing especially as to the shape of their ends, are made in it. These are the "black, soft catheters," originally of French manufacture, the employment of which is becoming so much more general as compared with metal instruments. They, like the first kind, have a woven basis, into the meshes of which some resinous preparation is incorporated, but they are much more flexible, and have nearly superseded the older make.

Shape.

They are sometimes made uniformly cylindrical, but more generally terminate in some special shape, designed to facilitate their passage. Of these the bulbous (*á boule*) or the olivary, (Fig. 204) is the favourite with most surgeons.

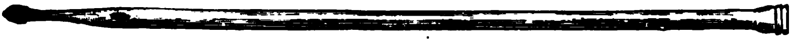

FIG. 204.—*Olivary Gum Elastic Catheter.*

The elbowed catheter again (Fig. 205) is often extremely useful, especially in prostatic cases, as will be directly explained.

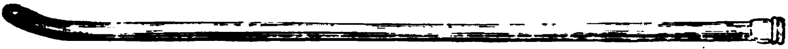

FIG. 205.—*Elbowed Catheter. (Catheter Coudé.)*

There are several other shapes of flexible catheters, among which we may mention Barnard Holt's conical or tapering one.

Signs of good gum elastic catheters.

The signs of a good gum elastic catheter are that it should be able to be easily tied up in a knot without any cracking of the surface, and that when its point is pressed upon with the finger, it should bend easily over in a uniform curve, and should not give way in an angular fashion at the eye.* Care should also be taken, if the instrument be a small one, that it is properly pervious. The eye should be clear, and with perfectly smooth edges; and, inasmuch as it is at this place that cheap, badly made instruments give way, especial attention should be given to the condition of this opening, and the catheter should be broken and discarded if any crack or flaw be there discovered.

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* See a Lecture by Mr. Teevan, *Lancet*, 1880, Vol. I., p. 119.

India-rubber catheters.

Of pure india-rubber catheters there are two or three varieties. The forms which have been made in this country have been principally devised with the idea that they shall be self-retaining when once introduced into the bladder. Thus they have been made with expanding wings, and other catches, or with a sharp elbow, straightened for the purpose of passage, by a stylet, but as yet none of these have been really successful.

"Jacques" catheter.

But there is a French kind of rubber catheter known commonly as "Jacques," which is of great value from its perfect softness and flexibility. It is made of a red rubber, and is most useful in cases where an instrument has to be left in the bladder, or where the patient has to pass one for himself.

Bougies.

Solid bougies are made of the same shape and size as the hollow catheters in both the gum elastic materials, and the two kinds differ from each other in respect of flexibility in just the same way.

"Bougies" proper, *i.e.*, instruments made of wax, with some woven basis, are now rarely used; introduced before the virtues of india-rubber were understood, they were then almost the only kind of flexible instrument possible, but they are now unnecessary and inconvenient. Wax may be used, however, as the vehicle in some forms of medicated bougies.

Two other forms of bougies should be mentioned, namely, those made of whalebone and of catgut. They are both very useful in difficult cases, where the finest instruments can hardly be passed. This is especially true of catgut, which may with patience be made to traverse very tortuous paths. They are sometimes moulded into a twisted or corkscrew form.

General points in the passage of any catheter.

General points in the passage of any urethral instrument.

There are some points common to the passage of all forms of catheters, and to a large extent of bougies also, which may be enumerated before we describe more particularly the passage of metal and flexible instruments respectively.

As to size.

I. *As to size.* It may be laid down as a rule almost without an exception, that in any given case the catheter which *should* be used is the largest which *can* be used, within the limits of the normal calibre of the urethra, so that in cases where there is no narrowing of the canal itself, a full-sized instrument should be chosen; and when there is a narrowing, as in strictures, the practice should be to work downwards from instruments which are too large, until one which will pass is reached; not upwards from those which are too small, to the same point. The reason for this rule is that, other things being equal, the smaller the instrument the harder it is to avoid catching in folds of the mucous membrane, or in the lacunæ of the urethra, and thus damaging it; on the other hand, the larger the instrument, the more likely is it to remain in the canal, and by stretching the lining membrane, to obliterate folds, and to pass by lacunæ, false passages, etc.

So, too, in cases of rupture of the urethra, a fair sized instrument, say, No. 8 or 9, may pass over the wound and into the bladder, when a smaller one would have its point engaged in the rent, and thus matters would be made worse than before, while in any case, if the larger one will not pass, the smaller is unlikely so to do.

As is well known, the meatus is in most cases the narrowest part of the canal, and it is sometimes so contracted that a full-sized instrument cannot be passed. In this case it may be carefully nicked with a pair of scissors, exactly in the middle line above and below, or below only, as may be required. Usually a very slight division of the tissues suffices.

Size of normal urethra.

In England it is generally held that a No. 12 catheter represents the calibre of a full-sized urethra, or rather that if No. 10 or 12 passes easily, it may be supposed that there is no stricture. This may be taken as true for most practical purposes, but American surgeons are more liberal-minded in their ideas, both as to the size of a normal urethra, and of the instruments which may be passed along it. Dr. Otis has shown that the average calibre of the male urethra in the living, is not less than 28 mill. (about No. 16 of the English catheter gauge), so that a stricture might diminish the urethral calibre 7 mill. (*i.e.*, from Nos. 16 to 12), before it would be detected by what most English surgeons, and most patients, consider a full-sized instrument. Dr. Otis has further shown that normal urethras differ greatly in their calibre, and that there is a close relationship between the circumference of the penis and the tube it contains.*

Importance of cleanliness of catheters.

II. The surgeon should personally assure himself that the catheters he is about to use are absolutely clean, and it will be well to wash them through with Condy or carbolic at the time of use. To use a foul catheter is to expose the patient, wantonly, to a distinct danger of blood poisoning, and it is a question whether the duty of cleansing catheters after use should ever be left to the nurses or porters.

How to clean.

After use the catheter should at once be cleaned; it should first be wiped to remove any grease, and a stream of water should then be passed through it from the eye. If necessary a piece of cotton wool may be wrapped round the end of the stylet, and the inside of the catheter freed from clots, etc. The instrument should afterwards be soaked in carbolic for twenty minutes (ten minutes for a soft catheter), and finally be allowed to dry perfectly before being put away.

Warming and oiling.

III. All instruments should be warmed and oiled before passing. The spasm will be greatly increased or diminished according as to whether this precaution be observed or no.

Constitutional disturbance.

IV. The passage of any instrument, but especially if it be a metal one passed for the first time, may be followed by marked constitutional disturbance, such as rigor, or repeated rigors, high temperature, etc. This *urethral fever*, or urethral shivering, as milder cases are called, is generally transient, but may even be fatal in damaged constitutions. Therefore it is that Sir James Paget † advises that a catheter or sound should if possible be passed for the first time, not in the surgeon's consulting room, but in the patient's own room.

Retention of catheters, etc., in the bladder.

V. Any form of catheter or bougie may require to be retained within the bladder, but the flexible kinds are borne much better than the silver ones, and the soft india-rubber ones best of all. It rarely happens that a metal instrument can be retained for more than twenty-four hours without setting up some cystitis.

It is hardly possible so to fasten in a catheter that the patient cannot remove it if he will, but it is not difficult to manage it so that it will not come out of itself.

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* For a full consideration of this question see Mr. Teevan's first Lettsomian Lecture, *Lancet*, 1880, Vol. I., p. 119.

† "Clinical Lectures," p. 65.

Whatever plan be adopted, if a flexible catheter be employed it is advisable to pass some form of stylet, about four inches long, down the commencement of the tube, so that the part which lies in the penile portion of the urethra should be stiffened.

The least efficient way of retaining an instrument is to tie a piece of tape round the handle, so that there are two short ends hanging down, one at either side; and then to fasten these tapes to the penis, by strips of plaster, very well warmed. Another way is to tie similar pieces of tape to the pubic hair on either side. (This answers very well in women.)

A very common plan, and one which is almost always efficient is shown in the accompanying illustration (Fig. 206). A piece of broad bandage, a foot longer than twice the circumference of the abdomen, is torn down so as to make a four-tailed bandage, the undivided central portion being a little less than the distance between the two anterior iliac spines of the patient. This part is laid over the front of the hypogastrium. The lower pair of tails, one on each side, are then passed behind the back, crossed, and brought round to the front, and tied together in the middle line. The upper pair are then twisted round the belt thus

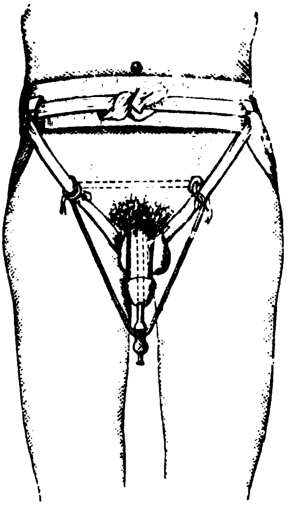

FIG. 206.—*Method of tying in a Catheter.*

formed, and passed round the top of the thighs, going backwards over the trochanters, and up through the crutch and across the groins to where they started opposite the iliac spines, where the ends must be fastened. The thighs are thus encircled by two loops, which hang from the top of the abdominal belt, and all that remains to be done, is to attach the centre of a piece of tape to the handle of the catheter, so that the two ends, one at each side, may be tied to the front of the loops, at the spot where they will retain the catheter most firmly.

If it be thought desirable, these tapes may further be tied together in the direction of the dotted lines in the figure. Another variation is to have four ends of tape, two on each side, one of each pair being fastened to the loop further back in the perineum, and the other a little further forward than the single one shown in the illustration, the two pulling against each other like the stays of a mast.

A plan, very similar to the above, is that figured by Mr. Heath in his Minor Surgery. A ring of ivory or gutta-percha encircles the root of the penis; the tapes are fastened to it, and it, in its turn, to the loops round the top of the thighs. This is probably the firmest way of all.

The passage of metal instruments.

Of the passage of metal catheters, etc.

In almost all text-books which treat of the practice of surgery, a verbal description will be found of the manœuvres necessary for the introduction of a metallic catheter into the bladder, but we believe that such descriptions are only waste of space, and of the author's and reader's time. We do not think it is within the power of words to convey to a student, who has no personal experience, any real idea of the movements of the hand and wrist, or of the complex sensations which guide and inform the surgeon of the position of the point of the instrument, of the direction in which it is travelling, or of the condition of the canal which he is exploring. Such descriptions are no doubt perfectly intelligible to those who know the direction of the urethra, but these stand in no need of them. The student will find further, that the knowledge of the anatomy of the pelvis which he has acquired in the dissecting-room, essential as it may be in other respects, will stand him in no stead in the actual passing of a catheter on the living patient.

There is only one way to learn to pass silver catheters, and that is, to pass them, at first of course under direction;

and it may not be out of place to remind house surgeons and dressers that they will in all probability never again have such opportunities of practice ; and although we are far from advising unnecessary catheterisation, still they will do wisely to seize all legitimate occasions for acquiring that most important accomplishment, the being "a first-rate hand with a catheter." *

We have already said that in passing catheters the rule should be to proceed downwards size by size, until the largest which will pass is arrived at. This is especially true of metal instruments. The smallest sizes, Nos. ½ to 3, are difficult to pass even along urethras which are healthy, and damage is readily inflicted by them.

Catheters of a very large size are chiefly employed in the operation of lithotrity for the removal of *débris*; or after perineal section, or, as has been mentioned (page 44), they may be required for the removal of blood clots. In passing them great care must be taken not to injure the urethra.

Passage of silver prostatic catheters.

Silver prostatic catheters are longer and more boldly curved than the ordinary ones. Generally speaking, a full-sized instrument (No. 12) is very easy to pass, slipping in almost by its own weight, but the use of metal prostatic instruments of a small calibre should be avoided, except for very good reasons.

Sounding for stone.

The house surgeon will frequently have occasion to explore the bladder for the detection of a calculus. The old fashioned sound was curved in the same manner as a catheter, and was passed in the same way. But more recently, an improved hollow cylindrical handle has been adopted, and a short bulbous end almost at right angles to the stem. These sounds are not so easy to introduce, but are much better fitted to thoroughly explore the bladder. Sounding should always be performed when the bladder contains a fair amount of urine; failing this, about half a pint of lukewarm water may be injected.

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* The dresser then should, from the first moment of entering upon his work, determine to learn how to catheterise, and may profitably set about it in some such way as the following. To begin with, he can conveniently learn the general direction of the urethra in children and adults, and pretty frequently, even in prostatic cases, by passing full-sized instruments in the dead house. And he will there also learn, to a certain extent, the "feel" of the normal urethra. He should then look out for cases, which will be fairly numerous in the wards, which require the regular passage of an instrument; such cases as those of chronic cystitis, atony of the bladder, paralytic cases, and the like. Having learned the normal urethra, he should now go on to cases of chronic stricture, where the urethra presents no difficulty, such as those which are on the high road to recovery, or in which the obstruction is only commencing; thence he may proceed to the more difficult ones, and to the use of the prostatic catheter, and so on till he feels that he stands on tolerably firm ground. In all those cases the house surgeon may be of the greatest assistance to the dresser in his ward and casualty work, and he may rest assured that help thus kindly and timely rendered will never be thought lightly of, nor forgotten in after years.

Passage of flexible catheters.

Of the passage of flexible Catheters, Bougies, etc.

The use of metal instruments is becoming every day less general, and that of flexible ones more so. The latter are less liable to produce constitutional disturbance; damage cannot be inflicted to the urethra by them, and they require no skill for their introduction. For all general purposes, the olivary shape (see Fig. 204) will be found the best, and cheap catheters are always bad and unsafe to use.

The method of introduction of the ordinary black, flexible catheters and bougies, or of whalebone bougies, or catgut, calls for no remark, but with regard to the stiffer form of gum elastic instrument, it should be mentioned that the style which serves to keep them in shape, should in almost all cases be withdrawn before they are passed.

In prostatic cases.

In prostatic cases it often happens that the ordinary olivary catheter hitches against the middle lobe of the gland, and will not pass. Sometimes it will be found that a very soft india-rubber one will ride easily over the obstruction, and still more often an elbowed instrument (*coudé*) will do so. But a good deal of manœuvering may be required in such a case. Thus, the finger may be placed in the rectum, or the perineum may be supported. Another method that sometimes succeeds in difficult cases is to pass a gum elastic catheter with a stylet bent to a sufficient curve, and when its passage is arrested, to withdraw the stylet for about an inch and a half. This may have the effect of raising the point of the catheter almost vertically over the lobe of the prostate, and if this occurs it will pass into the bladder upon the complete withdrawal of the stylet.

Sir H Thompson's plan.

Probably the best plan of all for the general run of cases is that recommended by Sir Henry Thompson,* namely, to keep a gum elastic catheter for a month or so upon an *over*

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* "Diseases of Urinary Organs," p. 113, Churchill's, 1876.

curved stylet; then when it has to be used, the stylet is removed and the shaft of the catheter bent back to the ordinary curve. In the passage down the urethra, through the spring of the catheter, the over curve is gradually re-assumed, so that by the time the prostate is reached, the point of the instrument rides over it.

Breaking of catheter in the urethra.

Lastly, it may happen, and perhaps more often than is generally supposed, that a defective instrument breaks off short at the eye, and that the fragment remains in the urethra. This accident should not occasion undue alarm, although the result may possibly be serious. If the piece can be felt in the penile or bulbous urethra, efforts may be made to work it forwards by manipulation until it can be easily seized by a pair of urethral forceps. If it can be felt, but cannot be moved, then these forceps may be very carefully passed down to it, every precaution being taken not to push it backwards into the bladder; but no good can come of plunging the forceps blindly into the urethra if the fragment cannot be felt. In such a case the best course is to send the patient to bed, to direct plenty of non-irritant fluids to be taken, and to diminish local spasm by means of morphia as a suppository or hypodermically, or by opiate enemata.

In all probability the missing piece will be passed in the urine within twenty-four hours, but if this should not be the case, no personal consideration on the part of the dresser or house surgeon, and no absence of symptoms on the part of the patient, should prevent an immediate report to the visiting surgeon, on whom will devolve the responsibility of deciding, firstly, whether the piece is still in the urethra, or is in the bladder, and, secondly, what further steps should be taken for its removal.

Of Aspiration of the Bladder over the Pubes.

Aspiration of the bladder over the pubes.

This has become the more common way of emptying the bladder by other than the natural passage, since it has been recognised that the operation may safely be repeated at short intervals; as many as a dozen aspirations being frequently performed.

The instrument used may be the one previously mentioned (see aspiration of abscesses) or the combination of aspirator and stomach pump, figured a few pages later, p. 486. In any case the operation is of the simplest; the points to bear in mind are, that the condition of the bladder must be accurately made out, and the thickness of its walls estimated as far as possible, for a bladder may be over-distended, and yet, through the muscular hypertrophy of its walls, may rise only a very little way over the pubic crest; that the aspirating trocar must be very sharp, so that the bladder walls, if thus thickened, may be readily pierced; and lastly, that the bladder must be entered fairly at right angles, just above the pubes. A fine trocar and cannula, not a pen-pointed hollow needle, must be used, and the best pattern is that in which the trocar acts as a piston, and when withdrawn through the cannula, allows the urine to escape by a side branch. The patient must be lying down whilst the aspiration is being performed.

Puncture of the bladder by the rectum.

Of Puncture of the Bladder by the Rectum.

This, at one time the only recognised method of puncturing the bladder, is now more rarely performed. But, supposing it to have been selected, the patient, who had better be anaesthetised, should be held in the lithotomy position at the foot of an operating table. The surgeon sitting in front of him, with his left forefinger feels for the trigone of the bladder, which, under the conditions of distension, will be obviously bulging into the rectum beyond the prostate. He then, with his right hand passes the curved trocar and cannula here figured (Fig. 207), with the trocar withdrawn into its sheath. Having satisfied himself that the end of the trocar is pressing against the base of the bladder, he withdraws his left hand, and with it holds the shield of the cannula steady. With his right hand he then depresses the handle of the trocar, and at the same time drives it onwards through the cannula and the bladder wall, which it should enter nearly at a right angle. The trocar should be very sharp, and the puncture should be quickly made. The trocar is then withdrawn, and the urine allowed to escape.

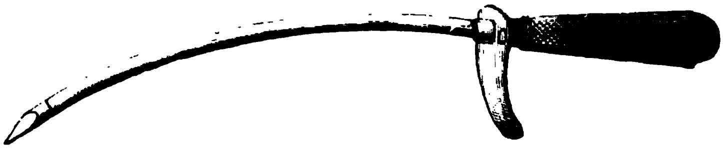

FIG. 207.—*Trocar for Puncture of Bladder by the Rectum.*

Not suitable in cases of enlarged prostate.

Cases of enlarged prostate are not proper ones for this operation, and it is the very frequent concurrence of this enlargement with retention, whether the retention be actually caused by it, or by a stricture, which has led to its general disuse.

The cannula may be withdrawn when the bladder is empty, or may be retained for a day or two, but not longer. The retention is not easy, and the instrument is extremely liable to slip out upon whatever plan it is tied in. The best way is to make an incomplete double T bandage (Fig. 65), and to stitch a piece of adhesive strapping, two inches square, to the inner surface of the perineal strip, just where it comes over the anus. A hole must be cut in the bandage and strapping to correspond to the aperture of the cannula, and the strapping must then be applied to its shield and the bandage tightened up. During defæcation, the only way is to hold the cannula in with the hand.

Of washing out the bladder.

Of Washing out the Bladder.

This operation is frequently required in cases of chronic cystitis. Whatever be the cause of this condition, and although the operation is easy enough, it requires some care to avoid giving needless pain, or harmful irritation. The fluids commonly used are plain water, or such acid, astringent, or anodyne preparations, as weak lotions of nitric, or nitro-hydrochloric acids, of nitrate of silver, or sulphate of zinc, or acetate of lead, or sulphate of quinine. Condy, sanitas, carbolic or boracic acid, or iodine are also used, and occasionally, some preparation of opium. A two-wayed catheter (Fig. 208) is often used for this purpose, and does well, although no better than other simpler plans. The instrument, which is made in silver, or gum-elastic, and which contains, as shown in the figure, two channels, with separate apertures, is inserted in the ordinary fashion.

By double channelled catheter.

FIG. 208.—*Double Channelled Catheter.*

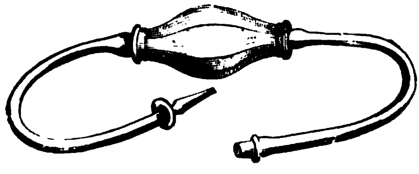

FIG. 209.—*Common Higginson's Syringe.*

The natural or straight canal is then connected with a tube, attached to some form of syringe (a Higginson's, Fig. 209, is about the best), and then a stream of the desired lotion is sent into the bladder, and returns by the other channel.

With syringe and catheter.

With tube, funnel and catheter.

Another method is to pass a full sized metal or flexible catheter, and to inject as before, but limiting the amount to well within the capacity of the bladder; when the syringe is disconnected, the bladder will eject the fluid, and the washing may be repeated. This is a tedious process, however, and all the advantages of the two-wayed catheter, without its complications, may be secured by passing a large catheter and attaching a tube with a funnel at its end. The tube should be not less than three feet long, and the funnel should first be held about a foot above the level of the bladder, and a sufficient quantity of fluid poured into it; this being done, the funnel should be depressed below the bladder level; both funnel and tube will now act as parts of a syphon, and the fluid will be effectually expelled.

To wash out the urethra.

The *urethra* itself has to be washed out in the treatment of gonorrhœa, and very rarely in that of other affections of that canal. The injection of warm water or of some lotion is generally done by the patient himself, with a glass syringe holding two or three ounces; a single syringeful being thrown up, retained for a couple of minutes and then ejected.

Ultzmann's method.

This method does well enough for affections of the spongy or membranous urethra, but may not effectually wash out the prostatic portion. When this is required to be done, a good plan is that recommended by Dr. Ultzmann,* namely, to pass a short silver catheter, *e.g.*, a female one, to just beyond the compressor urethræ muscle; then to inject ℥x to ℥xv of a mild astringent lotion into the bladder, and afterwards to allow it to be slowly and naturally expelled, so that the prostatic urethra is twice washed over.

This method we believe to be the simplest and the best, but in it, as in all others, care must be taken not to unwittingly produce too much distension of the bladder walls, and also, not to inject any air into the bladder cavity. The suffering which the presence of air there causes, and the difficulty with which it is expelled, are somewhat remarkable, when both the tolerance, and the power of expulsion of gas, shown by the neighbouring viscus, the rectum, are considered.

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* See notice of Dr. Ultzmann's book in the *Lancet*, Dec. 27th, 1884.

Of the passage of rectal bougies, enemata, etc.

Of the passage of rectal bougies, enemata, etc.

Bougies are frequently employed in the treatment of simple and syphilitic strictures of the rectum. These instruments are made of flexible gum elastic, vulcanite, metal, or wax. They are arranged in graduated sizes, and are either cylindrical or conical. Their passage is almost always painful, but wax bougies give the least suffering, and metal ones, the most; those of gum elastic are in most common use. They should be well warmed and oiled, and are best introduced while the patient lies on the left side. The right forefinger should be passed up to the stricture, and then the bougie passed along it, and thus guided into the aperture. No force should ever be used. As a rule the instrument is allowed to remain in some ten minutes or quarter of an hour; if the pain be great, a morphia suppository may be given either half an hour before the introduction, or immediately after the withdrawal.

Washing out the rectum.

Astringent enemata.

The operation of washing out the rectum, that is, the administration of enemata, need hardly detain us. The ordinary enema, given for removal of fæces, is generally given by the nurse; water, milk and water, or soap and water, being used. Again, enemata of alum, quassia infusion, etc., are given in the treatment of thread worms, and other astringent injections are used in *prolapsus ani.*

Opiate enemata

Stimulant enemata.

Mention has been made before of the effect of enemata containing opium, upon the irritability of the rectum and neighbouring parts, such as the bladder; and opiate enemata are also largely used in the arrest of such hæmorrhages as occur in typhoid fever, or dysenteric attacks. Stimulant enemata are also given in cases of shock or collapse, brandy, with beef tea, or egg, being the most common; the value of nutrient enemata is well known.

Passage of the long tube.

But the only strictly surgical point which arises in connection with the use of the enema syringe, is in those cases of obstruction, due to (1) a stricture low down, (2) from the pressure of some tumour outside the rectum, (3) a displacement of the uterus, (4) from simple fæcal impaction. In such, it may be necessary to pass "the long tube" as it is termed, and this should never be entrusted to a nurse. The tube, which is made of gum elastic, is like that of a stomach pump (*vide infra*). This must be carefully passed, with the finger in the rectum (like a bougie), for it is very apt to hitch in the upper part of that passage, and may do damage there; or it may become bent on itself, so that the eye appears at the anus when more of the tube is pushed on. In thin people, the position of the tube can be felt in the left iliac fossa, and the hand there may be used to guide it onwards. It is not easy to say how far the tube may be inserted, but with care, the commencement of the colon may certainly be reached.

As has been mentioned (Chap. xxvi), copious injections of warm water, olive oil, etc., may be given by the long tube. These should always be thrown up slowly, and the amount of distension of the colon observed.

It should also be mentioned that this tube is sometimes passed in cases of flatulent distension, and may give great relief.

Of the use of the stomach pump.

Of the washing out of the stomach, and of the use of the stomach pump.

The use of the stomach pump in cases of poisoning has been already several times alluded to, but it is employed on many other occasions as well, as for the feeding of refractory patients, or in the treatment of some forms of dyspepsia.

There are several forms of the pump, but a very common and convenient one is that here figured (Fig. 210), and which can also be used as an aspirator. It is made on what is known as the "flute-key" principle, and its action can be

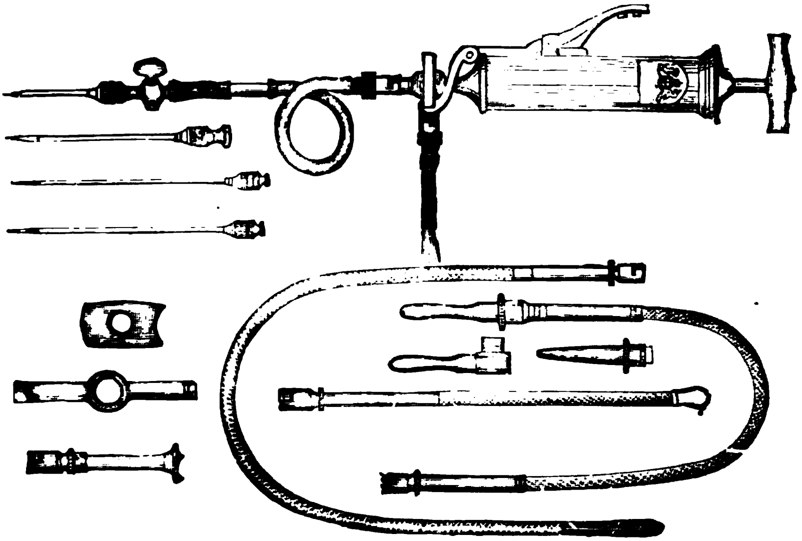

FIG. 210.—*Flute-keyed Stomach Pump and Aspirator combined.*

readily understood from the illustration, although it is there shown fitted up for aspiration. The tap of the pump is a two-wayed one, and if the piston were to be drawn out while the lever at the top in the figure remained in the position in which it is drawn, fluid would be sucked into the cylinder from the vertical tube, and similarly expelled by that tube, if the piston were afterwards pushed in. But if the lever be depressed, the vertical tube will be shut off, and the horizontal one (to which the aspirating needle is attached in the figure) will now be in communication with the cylinder and piston; so that, by depressing and raising the lever synchronously with the to and fro movement of the piston, fluids may be sucked from the vertical tube, and expelled by the horizontal one, or *vice versâ*, according to the relative position of the lever and piston.

Insertion of the tube.

The important point in the use of the stomach pump is the insertion of the tube. In restless or refractory patients it will be necessary to use a gag, and although almost any form will do, the best is a piece of hard wood, of such a size that it will lie across the mouth between the front molar teeth, and it should be broad enough to allow of a hole being bored through its centre, through which the tube can be passed. (*Vide* Fig. 210.)

In other cases no gag is required, and then the tube, which is made of gum elastic, having been well warmed and softened, can be passed with the right hand and guided by the left forefinger through the pharynx and down the gullet, with much greater ease. As soon as the end of the tube enters the œsophagus the choking usually stops. Supposing the case to be one in which the removal of something hurtful from the stomach is the object of the operation, after the tube has been passed, not less than half a pint of warm water, or of some special fluid, must be injected into the stomach before anything is sucked from it. The stomach may then safely be emptied, and the process of injection and suction repeated until the object is attained.

For removal of poisons.

In cases of poisoning, a pint of water, or of some bland, soothing fluid should be left in the stomach; as also in the case of simple drunkenness, unless it be desired to leave an emetic injection instead. If, however, the pump has been employed for the purpose of washing the mucous membrane, and removing the fermenting secretions of water-brash, or similar forms of dyspepsia, only that amount of fluid should be left behind which the pump will not readily remove.

But, as in the case of the bladder, the mechanism of a syringe with its taps and valves may be readily dispensed with, and the stomach may be washed out on the syphon principle very easily indeed. All that is required is the tube of the stomach pump, an india-rubber tube capable of being attached to this, and a funnel. The stomach tube having been passed, the tube and funnel are joined on, and then, by alternately pouring in fluid (the funnel being held about 2ft. 6in. above the level of the stomach) and then removing it by lowering the tube to an equal distance below, the operation of washing out the stomach can be reduced to its simplest conditions.*

For feeding.

If a tube, passed through the mouth, be used for the purposes of feeding, the patient will in all probability be a lunatic, or a case of cut-throat. In the one case the gag will almost certainly have to be used, and as the pump is somewhat quicker than the funnel and tube, it is perhaps preferable here. In cases of cut-throat, the nasal plan to be mentioned directly, is almost always to be preferred, but in any case, a small, soft india-rubber or gum elastic catheter should be used, in place of the common stomach pump tube; to this a tube and funnel may be attached, or the liquid food may be injected by means of a glass syringe.

Feeding through nose.

For the purpose of feeding, however, the introduction of fluid into the pharynx, or œsophagus (whence it is involuntarily swallowed) by a soft tube, such as a large catheter, passed through one of the nostrils has many obvious advantages. No gag is necessary, the food is actually swallowed, and the stomach is not disturbed by the presence of a tube. There is scarcely any discomfort produced, and the whole operation is of the simplest. All that is required is to choose a very soft No. 12 catheter, and to pass it for about eight inches through the nostril. If it does not go comfortably down the back of the throat, it may be passed on a curved stylet, which will give its end the necessary direction at the top of the pharynx, and which must then be withdrawn. The catheter being in position, it may be connected with a tube and funnel, or with a syringe, but the former is the more convenient.*

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* But a stomach pump tube, or a tube with a certain amount of stiffness is essential. We mention this because in some of the books, now produced in such numbers, which profess to have for their object the instruction of the general public in what should be done in cases of emergency, it is gravely stated that the patient should be made to swallow some feet of india-rubber tubing—and this in cases of acute poisoning!

Œsophageal bougies.

Œsophageal bougies are employed for the purpose of dilatation of simple strictures in this canal. They are also used for the purpose of diagnosis. With regard to their shape, etc., the best form is the olivary, as in urethral bougies, the medium and larger sizes of which are frequently used for the œsophagus, although of course much larger sizes still are commonly employed.

An œsophageal bougie should always be passed with very great care, and in cases of suspected malignant disease, or indeed, in all cases where the cause of the œsophageal obstruction is obscure, the house surgeon will not be justified in using this instrument on his own responsibility. On the other hand, it may be his duty, acting under his senior's instructions, to regularly dilate an œsophageal stricture, by bougies. With regard to the actual passage, the manipulation is the same as for the tube of the stomach pump, the left forefinger being used as a guide, while the well-warmed bougie is passed with the right hand. But the utmost gentleness must be exercised while the bougie is in contact with the stricture.

Hypodermic injection.

As we have been considering questions involving the use of various forms of syringes, this will be as convenient an opportunity as any to consider the performance of *hypodermic injection.* This method of administration was first introduced by Dr. Wood, and has been applied to a very large range of drugs, and also to stimulants, as ether (as we have already mentioned), and brandy, and even for the injection of nutritive food.

The syringe is also very commonly employed, not strictly hypodermically, for the purposes of diagnosis or for the removal of small collections of fluid.

Common drugs for injection.

Among the drugs which have been thus exhibited either for their general or their local action, morphia, atropia, strychnia, ergotin, preparations of iron and of mercury, chloroform, alcohol, ether, ammonia, iodine, carbolic acid, apomorphia, and permanganate of potash may be instanced. But inasmuch as the injection of morphia is so much more common than that of all the rest, and since the actual performance of the injection is almost the same in all cases, it will suffice for us to describe the rules for morphia injection.

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* A special form of nasal feeder, utilizing both nostrils, is made, but we do not know that it possesses any advantage over the above mentioned simpler plan.

The syringe.

Of the hypodermic syringe.

There are a number of patterns of hypodermic syringes, but their varieties involve no real difference of principle. They all are graduated to deliver the fluid to be injected, by measured drops, and it matters little if this be effected by a screw, or a thrust, piston. Fig. 211 is an illustration of a good form of the instrument.

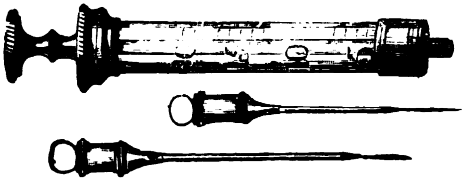

FIG. 211.—*Syringe for Hypodermic Injection.*

In Fig. 212 we have shown the manner of inserting the hypodermic needle. The special points to be observed are, (1) that the needle should be thrust into the subcutaneous tissue at some place where it is loose and where the skin is free from veins. (Unless it be desired to inject into the vein cavity, as in the injection of ether for extreme syncope, or of ammonia for snake bites.)

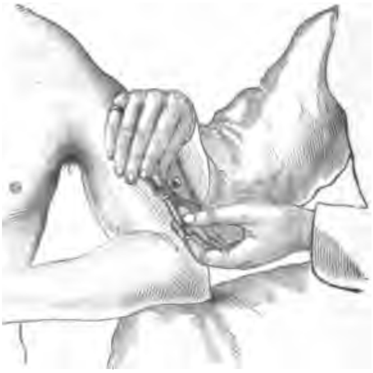

FIG. 212.—*Method of Hypodermic Injection.*

The fluid having been injected, the needle should be withdrawn quickly, and then, the puncture being covered by the point of the finger, the injected fluid should be dispersed into the tissues by gentle rubbing.

(2.) Another point in connection with the injection of morphia which may be mentioned, is that it every now and again happens that the administration of the drug in this way is followed by somewhat alarming symptoms of flushing, general pruritus, buzzing in the ears, and other signs of vasomotor disturbance, which somewhat resemble the commencement of an apoplectic fit. This derangement seems never to produce any permanent mischief, but it is well to know that it may happen, lest it should produce undue alarm. The dose of the morphia does not seem to influence the occurrence.

(3.) Lastly, and this point we would most strongly insist upon, no surgeon, house-surgeon, or dresser, should ever be induced to instruct a patient, or any one of the laity, in the art of self-injection. A syringe and a bottle of morphia are tools far too unsafe, and far too seductive, to leave in hands where they may be tampered with, and used, it may be unwittingly, as agents for self-destruction.

CHAPTER XXXVI.

OF TRACHEOTOMY, AND OF OTHER MINOR OPERATIONS OF SURGERY.

THE operations for opening the air passages are, taken altogether, the most serious which Resident Hospital Officers may expect to have to perform in the ordinary course of their work; and in London these operations have almost come to be considered as specially belonging to house surgeons. The custom has at least this to recommend it, that although in after years a practitioner may, if he so please, avoid almost all other operative work, he must always be prepared to arrest death from laryngeal obstruction. Moreover, although it cannot be said that all the tracheotomy cases which are performed in hospital for croup, diphtheria, etc., have become so suddenly urgent, or are admitted in such a condition of threatening asphyxia that there is no time to send for help, it is certain that in many instances this is the case; so that house surgeons must seriously consider, and acquaint themselves with all the details of this operation, as being one which they will certainly be called upon to perform.

We assume that the anatomy of the parts about the neck which are concerned is thoroughly understood, and in order to render the subject as simple as possible, we shall only treat of *laryngotomy*, or the insertion of a tube through the crico-thyroid membrane, and of that form of *tracheotomy* (often called the high operation) which consists in the division of the upper two or three tracheal rings, and possibly of the cricoid cartilage as well.

Laryngotomy.

Of laryngotomy.

This is a very simple operation, and is important chiefly because it is frequently necessary to perform it very quickly, as for the relief of sudden and acute œdema of the glottis in scalds of the larynx, or in cases of cut throat. It is also sometimes required for foreign bodies in the larynx itself.

May be done very quickly.

In very urgent cases, air can be admitted into the lungs with hardly a moment's delay by making a transverse incision of the breadth of a medium sized scalpel, with one plunge into the centre of the crico-thyroid membrane.

This aperture can then be kept patent by a pair of dressing forceps until a tube can be introduced. But if there should be time for somewhat more deliberate action, it will be better to make a vertical incision in the middle line, over the thyroid and cricoid cartilages, having for its centre the crico-thyroid membrane. This may then be opened transversely with greater convenience.

The manner of insertion, and of fastening in the tube will be the same for this operation as for the more difficult one, now to be described. The tube itself resembles one for tracheotomy, but is flattened so as to pass more readily between the cartilages.

Tracheotomy.

Of tracheotomy.

This operation is much more commonly required in infants and children than in adults, and for this reason, and because the younger the patient is, the greater are its difficulties, we shall here consider it as if it were required to be performed on a child of, say, five years of age; and we will further suppose that the cause of the respiratory difficulty is an attack of croup or diphtheria, the condition which furnishes the great bulk of tracheotomy cases.

Instruments required.

I. *Instruments required.* Tracheotomy instruments ought always to be kept together, so that no time need be occupied in collecting them when they are wanted in a hurry. The tracheotomy box should contain, firstly, the usual scalpels, forceps, artery forceps, Spencer Wells's forceps (at least two, see Fig. 18) scissors, probes, director, etc., which are required in all cutting or dissecting operations; also needles, silk, catgut, etc. The more especial instruments required are a pair of small retractors or blunt hooks, a Mathieu's three bladed forceps (Fig. 177) or some similar kind for facilitating the introduction of the tube; a sharp hook which may be grooved along the back as a director, a Trousseau's or Golding Bird's tracheal dilator (Fig. 178), and an assortment of tracheal tubes, with tapes, feathers, etc.

The tube.

The *tubes* used at the time of operation are almost invariably silver ones, and of these there are many patterns. They are all made in sizes, either three or four forming a set. A very common form is shown in Fig. 213. It consists of two tubes, the one fitting into the other, and the outer one having a shield of sufficient size to enable it to remain outside the wound.

Object of double tube.

The object of the double tube is to permit of the inner one being removed and cleansed as often as may be necessary.

Its drawback.

The great drawback to this tube is the difficulty of its introduction, necessitating the use of Mathieu's forceps, etc.

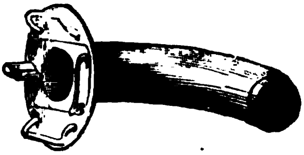

FIG. 213.—*Silver Tracheotomy Tube (ordinary form).*

Bivalve tube.

In Fig. 214 is shown a much improved form. This is the *bivalve* tube, also a double one, the inner tube of which resembles that of the first kind, but the outer is so cut away that when the inner one is removed (as it always is for the purpose of introduction) its two sides can be squeezed together into a wedge form, which can be easily pushed into the trachea.

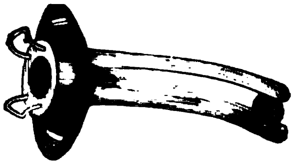

FIG. 214.—*Bivalve Tracheotomy Tube.*

Bryant's and Durham's tubes.

These bivalve tubes are more largely used than any other form, but two very good kinds are known as "Bryant's," and "Durham's" respectively. They are both double tubes, and both depend upon a "pilot," or curved introducer for their insertion. This pilot has a blunt-pointed end, which just passes through, and projects beyond the end of the tube, and thus serves to make it temporarily pointed. One is required for each size of tube. In Bryant's set, the pilot is solid and stiff, being curved exactly to the curve of the tube, but in Durham's, both it and the inner tube are made flexible, on what is known as the "lobster tail" principle.

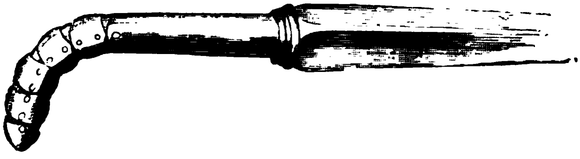

FIG. 215.—*Durham's Flexible Pilot.*

Figures 215, 216 and 217, are illustrations of Durham's flexible pilot, flexible inner tube, and one form of his outer tube. Two other improvements, which can be adapted to almost any form of tube, are the making the shield movable along the outer tube, so that it can be adjusted for fat patients where the trachea lies deeply, or for the reverse condition; and secondly, the giving a certain amount of play to the shield, by a half ball and socket movement, which in many cases saves the rigid silver tube from pressing dangerously against the cartilaginous rings.

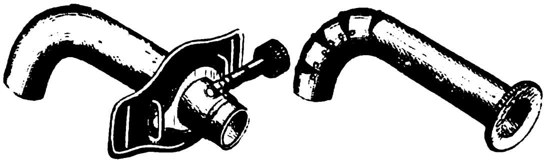

FIG. 216. FIG. 217.

FIGS. 216, 217.—*Durham's Flexible Outer and Inner Tracheotomy Tubes.*

Other tubes.

Tubes, other than silver. These are made in gum elastic (Fig. 218), celluloid, vulcanite, and in soft india-rubber. These last were introduced by Mr. Morrant Baker, and are extremely useful, especially in the later stages of tracheotomy cases. They may or may not require a pilot for their introduction.

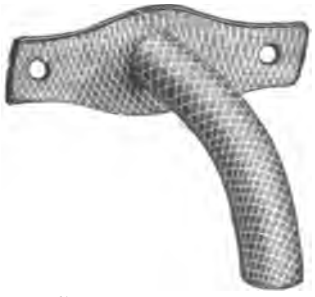

FIG. 218.—*Gum Elastic Tracheotomy Tube.*

Position of the patient and operator.

II. *Position of the patient and operator.* The position is of the greatest importance, for it is most essential that the middle line be absolutely adhered to throughout, and that the trachea be made to approach the surface as nearly as may be.

The child should therefore lie on its back, with a pillow between the shoulders, ceasing at the occiput so that the head and shoulders both fall somewhat, but not extremely back. The surgeon (if right handed) should stand at the patient's right hand, the chloroformist, if he be required, or some one who will steady the head, at the head, and the assistant opposite the surgeon.

Advisability of an anæsthetic.

III. The advisability *of an anæsthetic* varies. If one be given at all it should be chloroform, and when the case is not very urgent, and the child is capable of feeling pain or struggling, it seems to diminish spasm and to make matters easier for every one; but when the case is urgent, and the patient is getting colder and more feeble every moment, there is no capacity for feeling pain, and no time to be lost.

The tracheotomy.

IV. *The tracheotomy.* In performing this operation for the first time, the mistake is very generally made of proceeding as if the operator were in the dissecting room, instead of at the operating table. The temptation to use the knife, in order to get an anatomical display of the parts is very hard to resist, and it is not rendered easier by the fact that many written descriptions of the operation appear rather to favour this idea. But in fact, if the head be held still and straight, and the forefinger of the left hand be used to define and steady the cricoid cartilage, one incision, absolutely in the middle line should, in infants and children, be made from the cricoid cartilage nearly to the sternal notch,* dividing the tissues down to the fascia, and then *the knife need not be used again*, until the trachea is to be opened. Without removing the left forefinger, the fascia may be torn through with a director, and the parts displaced so as to get a perfectly free and sufficient exposure of the tracheal rings.

If the isthmus of the thyroid gland prevent a full exposure of the trachea, it may be torn through with forceps, or ligatured in two places and then divided.

Opening of the windpipe.

The assistant should now hold the sides of the wound apart with the blunt hooks or retractors, while the surgeon proceeds to open the windpipe. It is generally advised that the sharp hook before mentioned should be thrust into the first tracheal space, and the cricoid cartilage partly steadied, partly pulled up with the trachea, by its means. This may be necessary, but unless the trachea lies deep in consequence of fatness or swelling of the neck, it should be possible to avoid this disturbance of parts; and if so, so much the better, for the introduction of the hook is frequently the signal for a violent spasm, in the course of which the asphyxia is increased, and the bed of the trachea may be injured.

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* In a patient that is of the age we are supposing, this will give an incision of about 1½ inches. Many surgeons maintain that this length is excessive, but to those who have no large experience, the gain of a free exposure of the parts is very great and outweighs the slight increase of the risk of the downward tracking of pus. In skilful hands however, one small, direct incision, not more than an inch, or even ¾-inch, may be made straight down to the trachea. But for this the operator must know exactly what he is about.

Use of the sharp hook.

With the aid of the hook, or guided by the finger without it, two or three upper rings of the trachea can now be divided, the knife being entered edge upwards with a stab below the lowest ring concerned, and exactly in the middle line. The other rings are divided in the one incision; and if this does not give room enough, the cricoid cartilage may also be split. For this, a pair of strong blunt-pointed scissors will be found most convenient.

The incision of the trachea should be done deliberately, and the insertion of the tube which now immediately follows, should especially not be performed by any push in the dark; for the surgeon must satisfy himself that it has fairly entered the trachea.

Size of tube.

With regard to the size of the tube, in the case we are supposing (*i.e.*, in a child of five years of age), the second largest tube of the set of four will probably be the right one; but in every case the tube should be as large as can be admitted easily into the wound in the trachea of the patient,* and this will be, in the operation we have described, somewhat larger than the natural opening of the glottis.

If the bivalve or piloted tube be used, tracheal forceps will hardly ever be required, but for the common form (Fig. 213) it will often be necessary to dilate the edges of the tracheal wound with Mathieu's three bladed forceps, or some similar ones, or with Golding Bird's dilator.

Chief difficulties in this operation.

The chief difficulties which are met with in this operation are:—

Hæmorrhage.

I. *Hæmorrhage.* This is almost always due to the too free use of the knife, and is principally venous. It must be borne in mind that much, or all of it, will stop of itself directly the trachea is opened and the venous congestion removed. Moreover, time is very probably of great moment; it is therefore generally unnecessary to carefully secure the vessels, but a Spencer Wells's forceps may be clipped on, the weight of which, also, hanging down at the sides of the wound, can often be made serviceable for retraction.

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* See "Holme's Surgical Diseases of Children," p. 324.

It may, however, be necessary to tie divided vessels, and if a large vein be seen directly crossing the line of incision, it should be tied in two places and then cut.

Insufficient opening of the trachea.

II. *Insufficient opening of the trachea.* A blunt knife, or one unskilfully used, may slip along the cartilages, and only "nick" and not fully open the trachea. In this case the insufficient wound should be left alone, and another incision in the middle line made as described above.

III. As has been pointed out by Mr. Howard Marsh,* there may exist a dense exudation or false membrane, or a thickened condition of the natural mucous membrane, which is pushed before the point of the knife when it is made to enter the trachea, so that the air passage itself is not opened up; this may be avoided in some cases by taking care that the point of the scalpel is very sharp, and that it is made to "stab" the trachea properly, but if the membrane be very tough, it will be necessary either to pull it away with forceps, or to incise it separately, after the tracheal rings have been divided.

Cessation of respiration.

IV. *Cessation of respiration during operation.* If this happens during the early stages of the operation, the surgeon must choose between an immediate opening by laryngotomy, or completing with all possible speed the operation he has begun, and his decision will depend upon whether he anticipates any difficulty in at once finding the trachea. In any case the windpipe ought to be opened within a very few seconds.

It very often happens that the breathing stops at the moment of inserting the hook, or of opening the trachea, especially the first. This appears to be a kind of reflex inhibition, and is not in itself alarming. The surgeon should complete the tracheal incision as he intended, but of course quickly, and upon the insertion of the tube the respiration will almost certainly recommence. But in all cases, if the breathing has stopped, artificial respiration, and other restorative steps, should be energetically adopted, *as soon as the tube is in*, but the operation must never be intermitted (as we have seen done) for the purpose of artificial respiration.

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* *Brit. Med. Journal*, 1885, Vol. I., p. 200.

Non-insertion of the tube.

V. *Non-insertion of the tube.* The trachea may be imperfectly opened, and then the tube may be pushed down between it and the surrounding tissues. This may happen more easily than might at first sight be supposed. If there be the smallest doubt as to whether the tube has fairly and completely entered the trachea (thus one valve of the bivalve might be in, and the other out) the parts must be thoroughly explored, and if the opening in the trachea be not easily found, a fresh one must be made as before advised.

Shape of neck.

VI. *The neck may be very fat and short, or very swollen.* This is the special difficulty in the operation in infants. In them, the trachea may lie so deep that it may be very hard to find. Rigid attention to the middle line, and making the skin incisions sufficiently free, are the best precautions to take.

What we have written here will stand for tracheotomies performed for almost all conditions. But if it be for the removal of a foreign body, the trachea should be incised particularly cleanly, and, as has been before mentioned, the edges of the tracheal wound should be held apart with forceps, or Golding Bird's dilator should be inserted (see also p. 377).

After treatment.

After treatment of tracheotomy cases.

As soon as the tube is adjusted, and all the membrane which has presented itself has been removed, the patient should be put to bed in a cot with a tent-like arrangement over it, so that the steam from a bronchitis kettle may be led into it, keeping the air which is inspired always warm and moist. This is further effected by laying two or three folds of lint or flannel, wrung out of warm water, lightly over the aperture of the tube.

For the first few days after the operation very constant attention is required, and every tracheotomy case should have a special nurse for the first week at least.

The nurse (or dresser) must be on the watch against any sudden choking from plugging by a piece of dislodged membrane, and as soon as any presents itself it must be seized and removed. At regular intervals also, of an hour, an hour and a half or two hours, according to the amount of secretion, the inner tube must be removed and thoroughly cleansed, and at the same time a plumage feather, not a quill, well rubbed up the wrong way, should be passed down the outer tube into the trachea, to catch any pieces of membrane or more adherent mucus.*

At the end of three or four days it is often wise to substitute one of Baker's india-rubber tubes for the silver one, and about the sixth day the tube may begin to be left out, at first for an hour or two at the best time of the day, and soon for longer. For at least a fortnight it will be well to replace the tube at night. The house surgeon should be at hand the first time or two that the tube is taken out, lest there should be any difficulty in replacing it.†

When the tube is changed at the third or fourth day, it is a good plan to have a hole cut in the new one at the top of the arch of the tube, so that air can pass through the glottis into the lungs if it will, as well as through the wound. If a Baker's rubber tube be used this can be done with a pair of scissors, but silver tubes are also made with this aperture. If this method be adopted, it is easy, by placing the finger over the neck opening, at first for a few seconds, and afterwards for longer, to bring the glottis and vocal cords gradually into work again.

Intubation. Intubation has recently been advocated as an alternative to tracheotomy, more especially in diphtheria. To Dr. O'Dwyer, of New York, is due the merit of bringing the operation to its present state of perfection. The necessary **Instruments.** instruments are a gag, introducer, extractor, and tubes of various sizes; there is also a gauge to show the size of the tube suitable for the age of the patient. The tubes, of which there are usually five, are somewhat flattened, and vary in length from 1½ to 2½ inches, the smallest being suitable to a child under two years, and the largest to one between eight and ten years of age. Each tube has an enlarged head to prevent it from slipping into the trachea, and in the middle of its length is a fusiform enlargement to prevent it from being expelled. A hole is also drilled at one side of the head through which a long piece of silk must be threaded before the tube is introduced. Each tube is fitted with a jointed obturator, into the upper end of which the introducer is screwed, and on the latter is a sliding fork, which on being pushed downwards releases the obturator from the tube. The only use of the obturator is to facilitate the introduction of the tube. The extractor consists of a pair of forceps the blades of which are grooved on the exterior, so that on being passed into the tube and expanded, sufficient hold is obtained to enable it to be withdrawn.

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* Much has been written concerning the propriety or justifiability of the surgeon's sucking at the tracheotomy tube with his mouth in order to clear it of mucus or of false membrane. We will only here express our belief that no clearance of the air passage can be effected in this way which could not be much better done with a ruffled feather, or with a fine brush, and that we do not consider the proceeding to be either necessary or right.

† The reader is referred to a very interesting paper on the management of tracheotomy cases by Dr. W. E. Steavenson, for further remarks as to their nursing, and as to those cases in which the removal of the tube has to be delayed. See "Notes on Tracheotomy Cases," St. Bartholomew's Hospital Reports, 1882, p. 309.

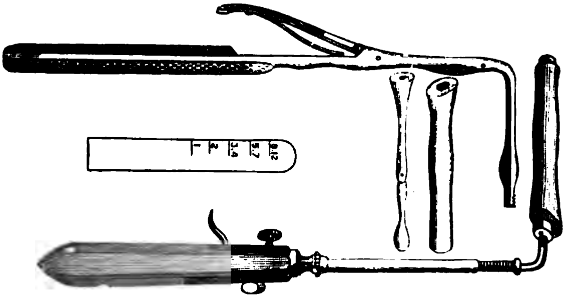

FIG. 219.—*Intubation Instruments. Above is the Extractor; below, the Introducer with Tube attached.*

The operation.

The steps of the operation are as follows. A suitably sized tube must be selected and threaded, and the introducer screwed into the obturator. The patient, if a child, should be wrapped in a shawl to prevent struggling and held on the nurse's lap, an assistant steadying the head. The gag having been introduced, the operator passes his left index finger over the epiglottis and feels for the arytenoid cartilages; with his right hand he then introduces the tube, taking care to keep it in the middle line, and passing the end of it between the tongue and finger. When the opening of the larynx is reached, the tube will be directed into it by raising the handle of the introducer. The tube being in the larynx, the obturator should be released, by pushing forward the button of the introducer, and withdrawn; the tube should then be pushed on with the finger until the head is in the rima. That the tube is in the larynx will be shown by the temporary dyspnœa which will occur. When this has passed off, the finger must again be inserted in order to hold the tube in position whilst the silk thread is cut and withdrawn. A tent and steam kettle must be used in the after treatment of the case as in tracheotomy.

Extraction of tube.

In extracting the tube the finger must be passed as before, and the blades of the extractor guided into the tube. If after one or two attempts the tube is not extracted, it is better to give the patient an anæsthetic.

In a case of diphtheria the tube will probably not be required for more than five or six days, but in a case of stenosis it may be worn for a much longer period.

Advantages of intubation.

Intubation has this great advantage over tracheotomy, that parents will often give permission for its performance while forbidding tracheotomy. The rapidity of its performance, the absence of risk from hæmorrhage, and from the giving of an anæsthetic, are also in its favour. On the other hand there are difficulties and dangers which must not be forgotten:—

Difficulties and dangers.

1. The difficulty of the operation. Considerable practice is required to insert and extract the tube, and it is most desirable to practise on the cadaver before resorting to it.

2. The tube in its insertion may push membrane before it and so block the trachea. Should this happen, and if the membrane cannot be extracted with forceps, tracheotomy must be done.

3. The tube itself may become blocked. In this case the tube will probably be expelled, and if this occurs before the tube can be dispensed with, the choice lies between its re-introduction and tracheotomy.

4. Difficulty of feeding. As the head of the tube interferes with the movements of the epiglottis, liquid food is apt to pass into the trachea and lungs and cause pneumonia. Recent improvements in the shape of the tube have to a certain extent lessened the chance of this occurring, but liquids must be given in small quantities, and attention paid to the position of the patient, who should be lying down with the head thrown well back when being fed.

It will thus be seen that after intubation even greater care and watchfulness are required than after tracheotomy.

Tonsillotomy.

Of Tonsillotomy.

The house surgeon is often required to remove portions of hypertrophied tonsils, and he will find that the cases vary greatly as to their difficulty; the age and disposition of the patient, the shape of the hypertrophy, the size of the aperture of the mouth, etc., all affecting the question.

The whole tonsil is never taken away, and speaking generally, the object of the operation is to get as large a shaving, or cut surface as possible, so that the pillars of the fauces may be tucked up by a process of cicatrisation. The removal itself may be performed by seizing the projecting mass with a pair of vulsellum forceps, and cutting off what is required with a blunt-pointed bistoury, the greater part of the blade of which should be guarded (a special tonsil knife is also made).

The guillotine. This was the old operation, and as such was strongly recommended by Syme, but now some form of *guillotine* is commonly used. The usual pattern is shown in Fig. 220.

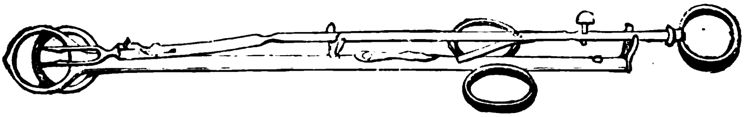

FIG. 220 - *Mathieu's Guillotine.*

It is a very ingenious and efficient instrument, but is somewhat liable to get out of order, and should always be tested before use. The dresser must learn how to take this instrument to pieces and put it together again, for only by doing this can it be properly cleaned, as it must be, after each time it is used. The especial feature of this (Mathieu's) instrument is, that by an automatic movement the tonsil is transfixed and *drawn further through* the encircling ring, at the moment that it is sheared off by the guillotine or circular knife. The extent of this traction is regulated by a screw.

This arrangement is often useful if the tonsils are flat, but if they project into the throat after their ordinary fashion, a much simpler tonsillotome (Mackenzie's, Fig. 221) does at least equally well. It is made to be adjustable for either side.

Mackenzie's tonsillotome.

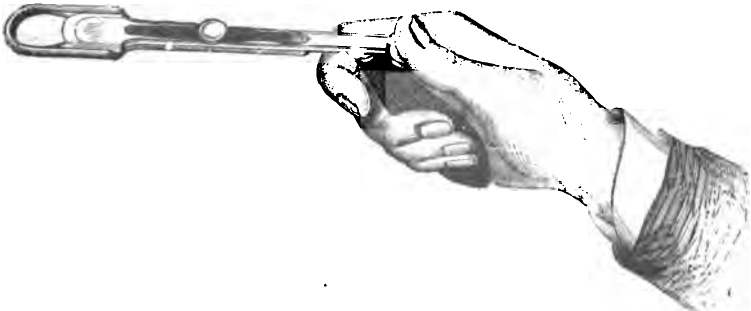

FIG. 221.—*Mackenzie's Tonsillotome.*

Tonsil scissors.

Lastly, *tonsil scissors*, with hooks for seizing the gland, are sometimes used, but they are the least convenient of all.

Question of an anæsthetic.

Whichever instrument is chosen, the question of an anæsthetic will be settled mainly by consideration of the probable behaviour of the patient. With one who can be trusted to sit still and keep the mouth open, it is much better dispensed with, for the operation is almost painless; but if there is likely to be any struggling (or in very young children) the surgeon will best consult his own convenience by having gas, or gas and ether, administered.

Position of patient.

The patient should sit in the same position, and with the same conditions of light as for the extraction of teeth (*q.v.*); if under an anæsthetic, a gag and tongue depressor will be required; if not, a simple spatula will suffice.

Direction of instrument.

Supposing the guillotine to be the chosen plan, its ring must be adjusted round the tonsil, taking care that the *axis of the instrument is directly from before backwards;* with a sharp sudden closure of the fingers the projecting part of the gland is then cut off.

If the direction of the instrument be kept in mind, it is impossible to injure any important vessel; indeed, it will often be advisable, and is perfectly safe, to press the tonsil into the ring of the guillotine with the fingers on the outside of the neck. The bleeding is generally slight, so that it may be easily checked by gargling with cold water. If it be more severe, an astringent gargle may be used. It very rarely happens that there is any profuse hæmorrhage, but if such should occur, ice should be kept in the mouth, or pieces held to the part with a pair of vulsellum forceps, or digital pressure may be made. If a vessel were to be seen spouting, it could be secured without much difficulty, but this is extremely rare.

Relaxed uvula.

The *uvula* is often relaxed and elongated from chronic congestion, and hanging down, produces tickling and irritation of the throat. It may, in this case, be shortened as much as may be necessary, and for this purpose a uvulatome, and also a pair of scissors of especial form have been made. Neither of these are in the least necessary; a pair of rather long forceps and sharp scissors are all the instruments which can be required to seize the uvula and snip it off.

Tenotomy.

Of Tenotomies.

Of this operation we need say little, for its chief difficulties concern questions of surgical anatomy. Moreover the house surgeon will only be called upon to do the operation in straightforward cases, and these generally under the supervision of his senior.

Instruments required. An anæsthetic is very advisable even in adults, and an assistant will be required to hold the limb. The instruments required are, one sharp, and one blunt pointed tenotomy knife (Figs. 222, 223); both, but especially the latter, should be very sharp edged.

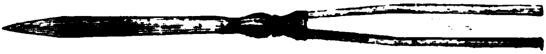

FIG. 222.—*Sharp Pointed Tenotomy Knife.*

FIG. 223.—*Blunt Pointed Tenotomy Knife.*

Method of operating. Taking as an example, a tenotomy for a simple equinus club foot, as being the one a house surgeon commonly operates on; the assistant holds the foot so that the tendon is relaxed, and the surgeon slips the sharp pointed knife beneath it, until the point is felt under the skin at the opposite side. He then withdraws it exactly as he put it in, and substitutes the blunt pointed one, in order to be able to cut close up to the skin on the side opposite his puncture without danger of dividing it. He then turns his knife edge outwards, against the tendon, and directs his assistant to gradually put this latter on the stretch. The knife now is made to divide its fibres by depressing the handle with a slightly sawing movement, giving the sensation as of cutting through somewhat fibrous celery. As the tendon becomes more nearly divided, the assistant must be careful, while still keeping up extension, that at the final parting, no sudden jerk occurs, which might cause the knife to come through the skin, for if the division be complete there should always be a kind of "snap," caused by the retraction of the upper (the muscular) end of the tendon. The knife is then carefully and quickly withdrawn, and a small pad of lint, which should be in readiness, is immediately put on and firmly secured with a larger pad over it, by a strip of adhesive plaster. The foot and ankle should then be bandaged with a flannel roller, and either left to itself, or bandaged to a flexible metal splint for three or four days, before any attempt is made to reduce the deformity.

Hæmorrhage It often happens that a small arterial branch of the posterior tibial is divided, and for a few seconds may bleed so freely that it may suggest the division of the trunk vessel.

This, however, is here hardly possible, and all that is necessary is to apply somewhat firmer pressure than usual for a few hours, watching the circulation in the toes, to see that the whole foot is not strangulated.*

Minor amputations.

Of Minor Amputations.

These may be primary or secondary, and if the latter, are performed as planned operations, and as such are fully described in surgical works. But as primary operations, necessitated by injuries to the hand, or foot, and especially of the former, we most strongly hold that the attempt to make miniature flaps, etc., results only in the sacrifice of portions of the limb which might have been saved. The vitality of these parts is so good, and every bit of hand or finger is so valuable a possession, that the right practice certainly is to save every scrap of the soft parts, in which there is a chance of vitality, which may serve to cover the bones, and to trim the parts up with scalpel, bone forceps, and scissors, without following any regular or orthodox plan of amputation.

The parts are almost always bruised badly, and must be lightly but warmly dressed. In those patients who are to be treated as casualty out-patients, even in the case of fingers, the whole fore-arm and hand should be splinted, for they will not otherwise rest the part; and in such cases also, sutures should be sparingly used, lest these patients should neglect to attend regularly, and thus suffer from pus being shut up in the wound.

Removal of foreign bodies.

Of the removal of Foreign Bodies from certain parts.

The question of foreign bodies in the air and food passages, and in the ear, has been discussed already, but some other examples remain.

Needles, splinters of wood, etc.

I. Needles, splinters of wood, etc,, often run deeply into such parts as the palm, or sole, and unless they project so that one end can be easily felt, may give great trouble.

These "needle cases," as they are called, are often occasions of much bad surgery, which may be indeed disastrous. For example, a servant runs a needle into her hand; it can be felt with difficulty, and the person from whom she seeks relief has neither the courage to leave it alone, nor to make a sufficiently free dissection to find it. He makes a small half-hearted cut, pulls and bruises the fibrous fat of the palm to no purpose, and covers it all up with a piece of strapping. Inflammation is the natural result of the double irritation of the needle and the bruised wound, and this, once started, may be of any severity, up to being fatal.

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* It is however not only possible, but easy, in the division of the tendon of the tibialis posticus, to divide the posterior tibial artery, but as we have said, the tendo Achillis is almost the only one commonly operated on except by the senior surgeon, or under his immediate direction, and for full descriptions of the anatomical and surgical difficulties of the division of the other tendons about the foot, about the knee, or the hip, the reader must be referred to systematic surgical works, or to works on Orthopædic Surgery.

When to be removed.

We believe that the rule to be followed is this. If a foreign body, such as a needle, can undoubtedly be felt, it must be taken away, and this can generally be done without trouble, even in situations such as the palm, if the superficial incisions be properly free. But supposing that the body can only be indistinctly felt, and that there is not sufficient irritation present to make it certain that it is there, it will be wiser to wait for a few days (watching the part carefully), when its locality will probably become more evident.

When extraction is not to be attempted.

Under no circumstances should an attempt be made to extract a supposed foreign body which cannot be felt at all, and which is not producing decided irritation. If it be unfelt, it is probably non-existent, and however confident the patient may be that it really went in, and is still there, this must not be taken as a proof.

Foreign bodies in the nose.

II. Small objects, such as boot buttons, beads, etc., are often pushed up the nostril, and may give great trouble. They may sometimes be removed by syringing, and sometimes by forceps. But the best way is to make a fine wire snare, and get it behind the obstruction. Sometimes, if the object is known to be small enough to pass the posterior nares, and if it lies very far back, it may be advisable to push it through into the pharynx.

The house surgeon may be called upon to pick out small shot, slugs, or grains of gunpowder, and, speaking generally, the sooner the extraction is performed, the better; but it may sometimes be right to leave them.

Foreign bodies in the cornea.

Small fragments of cinder, or chips of iron or stone, often become embedded in the cornea, and if they are not promptly removed will become firmly fixed, and may work great mischief. To get them away the patient should be placed in a good light (as in a dentist's chair); then the eyelids should be parted and held open with the finger and thumb so as to steady the eyeball, and the speck picked out of the cornea with the point of a small scalpel, or a "spud" made for the purpose. After the removal a drop of castor oil should be put between the lids. A small convex lens is often useful to concentrate the light, or to magnify the image of the body.

The operative measures which must be taken when a body has penetrated more deeply into the structures of the globe are of a much more serious character, and are fully discussed in works on ophthalmic surgery.

Nasal polypi.

Of simple Nasal Polypi.

These can be removed with forceps, or by a snare of a pattern similar to that shown in Fig. 194, while very rarely, the thermal, or electric cautery is useful.

These simple gelatinous polyps are generally pedunculate, and grow from one of the turbinated bones. They bleed readily, and obstruct and deform the nostrils.

Removal by forceps.

The patient should sit facing the light, as for the extraction of teeth, with a towel round the neck after the fashion of a bib. If forceps are used, the surgeon should endeavour to catch the pedicle and twist it off. Care must be taken not to mistake the end of the lower turbinated bone for a polyp.

By wire snare.

The wire snare is generally used for the larger growths, and it may be difficult to adjust it. The polyps often hang down into the throat behind, and then the finger will have to be passed behind the soft palate in order to get the wire round them.

By cautery.

The cautery will be found to be the best plan for small fleshy polypi, which may bleed profusely if removed in the ordinary way, and the most convenient form is the small platinum point of Pacquelin's Thermo-Cautery; it may also be possible to scrape away with the finger nail some of the growths.

The polyps havingbeen removed as completely as possible, the freedom of the nostril should be ascertained by directing the patient to blow through it, and the bleeding checked by syringing with cold water. The patient should then be directed to use an astringent snuff (equal parts of tannic acid and nitrate of bismuth do very well), and sometimes the application of solid nitrate of silver will be found advisable.

It often happens that, when all the polypi which can be seen at the time of the operation have been removed, within a day or two others present themselves to view, which have hitherto been kept up in the upper parts of the nose by the pressure of the lower ones. These must be treated in the same way.

Thickening of the mucous membrane of the nose.

A condition of *thickening of the mucous membrane of the nose*, with hypertrophy of the turbinated bones, is very common in strumous people, and resembles true polypoid growths somewhat closely. It is generally treated by strong local astringent lotions, or snuffs, and recently chromic acid as a caustic has been recommended. The pure acid is applied by fusing small crystals of it over a lamp upon a silver probe to which they will adhere.

Removal or evacuation of small sebaceous cysts.

Small sebaceous cysts often call for removal or evacuation. This latter method is not practised as often as it should be. In a large number of instances if a little trouble be taken, the aperture into the cyst can be found, and can be dilated, beginning with a lachrymal probe, and going on to an ordinary one. The contents can then be squeezed out, after which the patient should be instructed to keep the opening patent, and to squeeze the secretion out regularly; after a little time it will cease to accumulate.

But these cysts very often have to be cut out. It is generally recommended that they should be cut across, their contents turned out, and the cyst wall seized with a pair of dressing forceps, and pulled away. This method is very apt to leave portions of secreting membrane behind which will suppurate, and we think it is always wise to take the little additional trouble which is involved in the careful dissecting away of the whole sac, if possible without opening it at all. The clean wound which is thus left readily heals up under any simple dressing.

Tarsal tumours.

The allied condition which is found in the eyelids, the retention cysts of the Meibomian glands, commonly called *Tarsal Tumours*, are treated differently. They should generally be left alone until the skin over them looks bluish and thinning (Lawson). The lid (usually the lower one) is then everted, the conjunctiva and cyst wall incised, and the contents broken up and turned out with a scoop, such as is found at the end of a common probe. The incision should be prevented from healing for a short time by passing a probe along it every day. If the wall be very tough, or the contents solid, it is wise to rub the inside of the cavity with lunar caustic.

Of nævi.

Of Nævi.

We will here consider *cutaneous* or *capillary nævi* (mother's marks), and the smaller subcutaneous ones. With regard to both, but especially the former, one fact is often forgotten, indeed, seems hardly to be generally known, namely, that if left alone they will very frequently disappear. To show this, let the reader consider how very rarely the affection is met with in adults as compared with the number of children who are brought to the O.P. rooms for treatment.

Often disappear spontaneously.

It is, therefore, in infants, a good general rule to postpone treatment, for a month or two at least, after they are first seen, unless the stain be rapidly growing, or be in a very disfiguring situation.

Of superficial nævi.

The only way of treating *superficial nævi* is to destroy them with some form of caustic or cautery. *Nitric acid* will generally be found best, but Dr. Richardson's ethylate of sodium or strong chloride of zinc may also be used. It is only waste of time to employ the milder caustics, as the nitrate of silver, alum, etc.

By nitric acid.

Sometimes the nævus is vaccinated, and the consequent inflammation may be sufficient to effect a cure, but it generally fails.

By actual cautery.

Any form of actual cautery may be successfully used, Pacquelin's being the most convenient. The whole depth of the skin must be destroyed, and the parts dressed in some simple fashion while the sloughs separate.

In situations, such as the face, where complete destruction of a large superficial nævus would leave a disfiguring scar, good may occasionally be done by slight superficial applications of the cautery, frequently repeated, a small portion of the nævus being done at one time. If successful a thin white scar will ultimately be formed, but the treatment is long and tedious.

Of subcutaneous nævi.

There are two principles on which *subcutaneous nævi* may be treated; that is to say, measures may be taken which will produce sloughing out of the entire mass, or which will merely produce a consolidation and stasis of the blood current through it, which consolidation is later followed by a gradual absorption.

By ligature.

For the *ligature* of a subcutaneous nævus of ordinary size, the readiest way is to take a needle, double threaded with stout silk or whip ord, and with it to transfix the base of the growth. The needle having been cut off, there will be left two cords running below the tumour, and these may if necessary be increased to four or six by repeating the process of transfixion. The cut ends of these ligatures have now to be knotted together very tightly, each to each, and before this is done it will almost always be advisable to cut the skin in the form of a ring at the base of the growth. The nævus will then be completely strangulated, and must be left to slough off. During its separation it may be dressed with fomentations, or with any simple cleanly dressing.

Sometimes elastic ligatures, or ones which can be tightened up from time to time are used; but in any case the cords must be tied very tight.

The means which may be adopted for securing consolidation of nævoid growths are numerous, but we shall only mention one or two of the principal ones.

By electrolysis. Electrolysis or the passage of a constant current, finds an application here, its object being to produce stasis and coagulation in the blood vessels, but not sloughing of the tissues. The current should be just strong enough to decompose water; and the needles must be insulated with the exception of about a ¼ inch at the end, to prevent the current from acting on the skin and causing sloughing. One needle is connected with each pole of the battery and inserted into the tumour, care being taken that the non-insulated portion is buried in the nævus. The current is passed until the swelling becomes white and hard; it must then be reversed for a short time to prevent hæmorrhage. If the nævus be deeply seated, the effect will have to be estimated by the hardening of the tumour. The operation frequently has to be repeated, and it is often advisable to use more than two needles, especially if the nævus be large.

By setons. One of the most common plans of treatment, and a very successful one, is the passage of threads, soaked in the strong tincture of the perchloride of iron, through the substance of the growth. It is best to use worsted, as it takes up more of the tincture, double threaded through a stout needle. Three or four of these double threads may be passed, and their ends may then be loosely knotted together, and cut short. After a few days they will begin to work loose in their channels, as seton threads do, and should then be removed. The action of iron perchloride in effecting consolidation of nævoid tissue is very marked.

By cautery. The actual cautery may also be used, multiple punctures being made into the nævus. Cure takes place by a mixture of sloughing and consolidation.

By injection. The liquid iron perchloride, and other fluids, are also sometimes injected into these growths with a hypodermic syringe, but although stasis and consolidation may thus be produced, the risks of thrombosis and embolism prevent this method of treatment from becoming common.

Small subcutaneous nævi, which are distinctly encapsuled, may often be dissected out, and although the operator requires to be careful to avoid cutting into the small tumour while it is being removed, it is a very satisfactory treatment, though not one which is generally applicable. All bleeding ceases as soon as the nævus is taken away.

Of piles.

Of Piles.

External.

External piles give little trouble to the surgeon. They may always be snipped off with a pair of scissors, the cuts being made in a radiating direction, and there is never any hæmorrhage which pressure will not arrest. The only point to be kept in mind is the risk of contracting the anal orifice by taking away too much skin.

Internal.

But *internal* (mucous) and *muco-cutaneous* piles require more careful treatment, and we will here consider the chief plans which are adopted.

Treatment.

These are, *the ligature, the écraseur, the clamp, and the clamp and cautery*, and of these the ligature is still the most commonly employed.

Preparation of patient.

Whichever plan is to be followed, the rectum must always be thoroughly cleared out with an enema, and it is frequently a good plan to direct the patient to sit and strain, as if at stool, over a bucket half full of very hot water, so as to bring the piles down as far as possible, just before the operation.

An anæsthetic should always be given* and the patient is most conveniently placed in the lithotomy position; the surgeon then fully dilates the sphincter ani, and brings down the piles, or as many of them as he proposes to remove, with his finger or with vulsellum forceps (Fig. 224), and keeps them protruding from the anus.

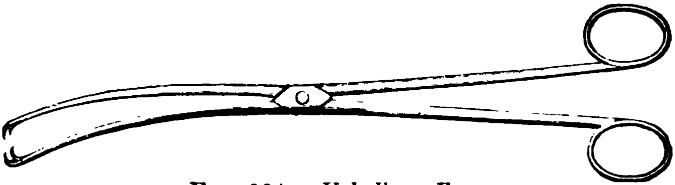

FIG. 224.—*Vulsellum Forceps.*

By ligature.

If the pile be of moderate size, it must be drawn well forwards, and, supposing the method by ligature to be chosen, its base should be transfixed with a strong needle fixed upon a handle (the best pattern is one bent at right angles, about an inch away from the point, and with the bent end curved on the flat), which should then be double-threaded with stout whipcord, well waxed. The needle is then withdrawn, so that there are two threads running across the centre of the base of the pile. The next step is to divide the skin where the pile encroaches on it, and also the mucous membrane, all round the base of the pile, with a pair of curved scissors. This greatly shortens the time of separation, and diminishes the pain of the ligature, but of course care must be taken not to cut into the pile.

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* Unless local anæsthesia has been produced, as by cocaine. See note p. 419.

All that now remains to be done is to tie the pile in two halves with the two cords. This strangulation cannot possibly be done too tightly, and the ligatures must lie in the trenches which have been cut for them. One of each pair of ends of cord may then be cut short, the two portions of the pile may be separated with scissors from each other, and then the whole mass is generally returned within the anus, there to come away by sloughing; but it is sometimes advisable, and if the ligature be properly tight, is safe, to cut off the two halves of the pile itself, and return the pedicles only.

Quite small piles do not need transfixing and splitting, but may be tied in one piece, the mucous membrane being snipped all round the base as before.

Very large piles, or masses of piles, on the contrary, will require to be ligatured in several places, but the principle remains the same.

After management.

After any operation for piles, it saves much pain to place a morphia suppository in the rectum, and throughout the time of the separation of the ligatures, say from five to seven days, opium may be required to allay pain, and for the first three or four days after, also for the purpose of confining the action of the bowels. After this time, laxatives should be given, so that the stools may be soft.

By clamp and cautery.

Though the ligature is still the most common way of treating internal piles, it is quickly becoming displaced by other less painful methods. Of these the best known is that of the *clamp and cautery*.

In this method the piles are drawn down as before, and then seized with a screw clamp (Fig. 225), the blades of which are made parallel, and have ivory plates attached to them, as non-conductors of the heat of the cautery.

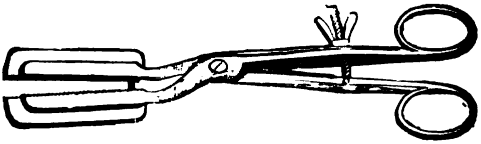

FIG. 225.—*Cautery Clamp.*

The pile is firmly clamped, and then cut off with one of the knives of a Pacquelin's cautery, at an almost invisible red heat, and very slowly applied; or with some other form of cautery; or with a scalpel and pair of scissors. The surface afterwards must be thoroughly cauterised before the clamp is removed, this removal being done gradually, so that if there be any spouting, the jaws can be tightened up again, and the cautery re-applied.

By crushing. By other methods, even the cautery is dispensed with. Thus by means of a powerful clamp, such as is here figured (Fig. 226), the pile having been drawn down, may have its base so thoroughly crushed* that it may be at once cut off with a pair of scissors. The clamp should remain on the stump of the pile for about two minutes.

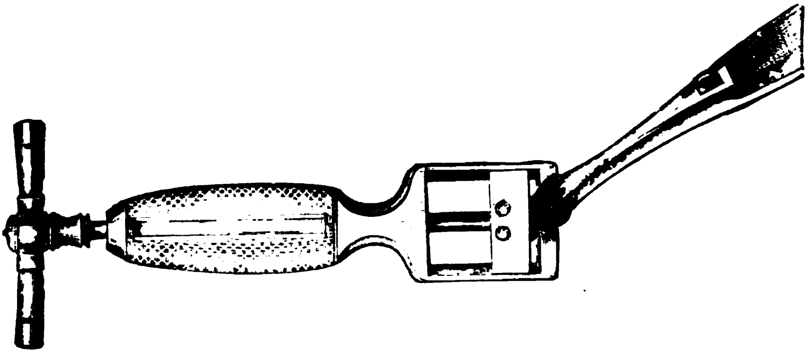

FIG. 226.—*Clamp for crushing Piles.*

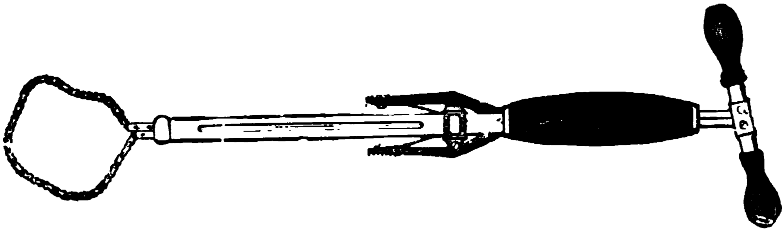

FIG. 227.—*Chain Écraseur.*

By the écraseur. A chain écraseur (Fig. 227), worked slowly (say one link in about 10 seconds) is also a very efficient form of removal.

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* See *Lancet*, July 3rd, 1880, for explanation of the method; where, however, a different form of clamp (Benham's) is figured.

In principle its employment does not differ from the other methods we have described, and the preparation and after treatments are alike in all. The écraseur may be used to remove a small pile whole, or larger ones in two or more portions, one end of the chain being passed through the base of the pile, as was the whipcord in the case of the ligature. The mucous membrane should also be similarly divided, in a ring, by the scissors.

By nitric acid.

Again, internal piles may be brought down, clamped, and thoroughly cauterised with strong nitric acid. This treatment is especially applicable to florid sessile piles.

Whitehead's operation.

Where the hæmorrhoids are very large and involve the entire circumference of the bowel, the operation devised by Whitehead is most likely to effect a permanent cure. It consists in removing the mucous membrane, and with it the hæmorrhoids from the lowest 1½ or 2 inches of the gut.

The sphincters having been stretched, the mucous membrane is divided with scissors at its junction with the skin all round the anus. The ring of mucous membrane is then separated from the muscular coat as high as may be necessary; this is best done with scissors. All hæmorrhage must be stopped by forcipressure, and, if necessary, fine silk ligatures. The detached mucous membrane is next divided above, a small piece at a time, and the edge of the mucous membrane is brought down and sutured to the skin. If the entire segment were removed before commencing to suture, there would probably be very troublesome hæmorrhage. A morphia suppository should be given, and a dry antiseptic dressing applied. The after treatment consists in frequent syringing of the part with an antiseptic lotion, the sutures being allowed to come away of themselves. The greatest care must be taken to obtain union by first intention, otherwise there will be great risk of the formation of a fibrous stricture.

Of painful fissure or ulcer of the anus.

Of painful Fissure or Ulcer of the Anus.

Small, but very painful cracks, or small ulcers, are often found at the margin of the anus, and although they are very insignificant in appearance, they may render life almost intolerable.

Treatment.

Lunar caustic, nitric acid, or a touch with the actual cautery will sometimes cure them, the treatment being combined with the use of astringent enemata; but in severe cases there will be hardly any improvement unless, in addition to such applications, the superficial fibres of the sphincters in the neighbourhood of the ulcer are set at rest, This may often be done by inserting the thumbs within the anus, and suddenly stretching the part; or a rectal dilator may be similarly employed.

But the most certain way to attain this rest is to incise the base of the fissure in its whole length, so as to divide the fibres of the sphincters which have, by their spasm and irritability, prevented the sore from healing. To do this effectually, an anæsthetic will be required, and a speculum is very necessary to ensure a complete view of the parts.

It often happens that these fissures are in connection with small piles, and occasionally with polypa. These must be removed at the time the fissure is incised.

Of prolapsus ani.

Of Prolapsus Ani.

In infants.

This condition is found in children and adults, but is more frequent and much less serious in the former. Infants are very often brought to the casualty room with the complaint that "their body comes down," every time that the bowels are opened. The patients will generally be weakly and ill-nourished, and on inquiry it will often be found that they have been allowed to crouch for as much as a quarter, or it may be, half-an-hour, upon a chamber pot. The first direction which must be given is that a proper chair be provided, and that the child is not to remain upon it a moment longer than is necessary. The protruding anus, or rather the rectum, must be returned each time that it comes down, and the opportunity may be taken to apply an astringent lotion (as 2 gr. of sulphate of iron to an ounce of water) to the part. The buttocks may be douched with cold water, anything like constipation avoided, and general tonics, as Parrish's food, given.

General treatment.

By truss, plug, or pad.

Under such general treatment, most cases of prolapsus in infants will very quickly get well; but if the case be more severe it may be necessary to apply some kind of spring truss, made on the principle of those for uterine displacement, or some kind of plug or pad, one pattern of which is shown in Fig. 228.

When the prolapse is the result of worms or rectal polypi the removal of these will usually effect a cure.

In adults.

But prolapsus in adults is a more serious affair, and may require extensive operative treatment. Supposing that the case does not yield to a patient replacement of the gut, with the application of astringent lotions, the surgeon may use a stronger caustic application, as the lunar caustic in the solid form, or in strong solution, or nitric acid; or may score the mucous membrane over with the Pacquelin's cautery, taking care in each case that the caustic or cauterising action be limited to the mucous tissues. The prolapse should then be returned, and the case treated in the same way as if it were one of internal piles.

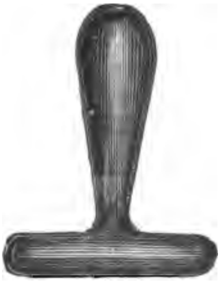

FIG. 228.—*Plug for Prolapsus Ani.*

In more severe cases still, portions of the prolapsed membrane may have to be removed with the ligature, clamp and cautery, or écraseur, as in the case of piles, but these measures are too serious to find a proper place here.

Of Fistula in Ano.

Of fistula in ano.

We shall here only consider the less serious form of this affection, and will suppose that in all the cases with which we have to do, the fistula is one which involves only the lower inch-and-a-half, or so, of the rectum, and is thus well within the limits of safety as regards hæmorrhage. In most cases the fistulæ commence as ischio-rectal abscesses, more or less acute at first, and afterwards becoming chronic. On examination a small, often a very small, aperture will be found, which on pressure will exude a little thin sero-pus; and on probing, this will be found to lead along a small channel, tending in the direction of the rectum.

Treatment.

The only efficient treatment for this condition is to lay this sinus open, so as to convert it into a trench opening along its whole length into the rectum, and by subsequent management to force it to heal up from the bottom.

In all fistulæ the actual operation is much easier than the conscientious carrying out of the subsequent dressing. The readiest way to cut a fistula is to take a Brodie's fistula probe (Fig. 229), to pass it along the sinus, and if possible,

FIG. 229.—*Brodie's Fistula Probe.*

to find the natural opening into the rectum; if this is non-existent, or lies too high up, the end of the probe must be pushed through the rectum, wherever the sinus seems to come closest to the mucous surface.

As soon as the finger placed in the rectum feels the end of the probe, the instrument should be pushed on further and turned, so that its end comes out at the anus; the sphincters (one, or both, if both are involved), and all the tissues between the sinus and the rectum must then be divided by a curved, sharp pointed, bistoury.

It sometimes happens, even in the simple fistulæ we are considering, that a probe passed along the sinus cannot be turned out of the rectum in this way; if so, a director of the ordinary pattern should be passed along the track, a curved probe pointed bistoury should then be passed along its groove till its point is felt by the forefinger of the left hand, placed in the rectum, and against the end of the director. This finger must then be kept in contact with the end of the knife while both are withdrawn. In this way the tissues between the fistula and the gut will be divided as before.

The sinus itself having been slit up, it is necessary to perform certain trimming details, in order to ensure a sound healing. Thus the bottom of the trench into which the sinus is now converted, should be incised along its whole extent, and oftentimes it will be wise to scrape out the granulation tissue which lines it, with the scoop which is here figured (Fig. 230); the unhealthy margins also should be freely clipped off, the best instrument for doing this being the fistula scissors (Fig. 231).

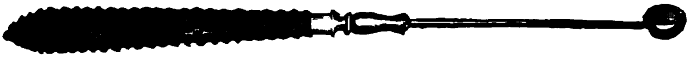

FIG. 230.—*Scoop for Scraping Sinuses, etc.*

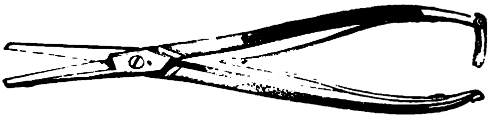

FIG. 231.—*Scissors for Trimming Edges of Fistulæ, etc.*

When all this has been done, the wound must be carefully packed with narrow strips of lint, or with absorbent wool, and the whole secured with a T bandage. There is hardly ever any bleeding which moderate pressure will not arrest. An anæsthetic will be almost always required, unless the parts have been rendered insensitive by cocaine, of which 10 ♏ of a 4 to 8 per cent. solution might be injected along the sinus, and a similar quantity into the fibres of the sphincter ani.

However thoroughly a fistula may have been operated upon, the ultimate success or failure lies absolutely in the hands of the dresser. If, through carelessness, he allows the channel to roof itself over, no good will have come of all the surgeon's efforts; he must, therefore, most patiently plug the wound quite from the bottom, so that it granulates soundly. It matters little with what he does this; a web of cotton wool, narrow strips of lint soaked in carbolic or eucalyptus oil, or in Friar's balsam, or several other dressings will all do about equally well.

Of phimosis, paraphimosis, etc.

Of Phimosis, Paraphimosis, etc.

Of circumcision for phimosis in children.

Of Circumcision for Phimosis in Children. In the first place it may be stated that all children with a long foreskin will be placed in a better position, morally and physically, by being circumcised, whether they have a true phimosis or no; but these considerations apart, it is certain that many young children who have a certain amount of contraction of the aperture of the foreskin, but in whom the skin itself is not specially redundant, are subjected to circumcision quite unnecessarily. In a great number of these cases, all that is necessary is that the orifice should be dilated with a pair of dressing forceps, and the foreskin peeled from off the glans penis to which it is generally adherent.* But if the amount of the foreskin be distinctly redundant, whether the orifice be contracted or not, a circumcision should be performed, and in children this is a simple operation. An anæsthetic having been given, the foreskin should be drawn well forward over the glans, and held between the jaws of a clamp, such as a hæmorrhoidal clamp (Fig. 225), or of a pair of dressing forceps, but not so tightly as to bruise the parts (a pair of parallel rulers do admirably for this purpose).

Dilatation.

The operation of circumcision in children.

The redundant skin should then be cut away, and if the mucous surface be adherent to the glans it should be peeled off. There will now be an extensive ring of raw surface round the glans, between the edge of the mucous membrane and the edge of the skin, which has retracted. The next step is to cut through the mucous membrane down the dorsal middle line to the level of the skin margin, and then, turning the mucous surface over, to attach the skin and mucous edges round the organ by a few points of suture, silk or catgut being the best to use.

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* Mr. Richmond has described a convenient instrument for the gradual dilatation of the prepuce. *Lancet*, 1884, Vol. II., p. 544.

There are not more than two arteries which ever seem to require tying, but in these soft tissues ligatures are best avoided. This can always be managed by keeping a couple of Spencer Wells's, or torsion forceps, on the bleeding points for a minute or two. The dressing of the wound should be perfectly light and simple; a piece of carbolised oil lint does as well as anything.

Circumcision, etc., in adults.

Circumcision, and slitting up the prepuce in adults.

This operation may be required, as it is in children, for congenital phimosis, and in such cases will not differ at all from that we have just described; but it may also become necessary in consequence of an acquired contraction of the foreskin, and this again may be due to an inflammatory condition which is present at the time of operation, or to one which has passed off.

If a long foreskin be in a state of acute inflammatory œdema, it may be necessary to expose the glans penis for urination, or for the purpose of getting at sores, etc. In such a case no planned circumcision is called for, nor would the results be satisfactory. All that can, or need be done is to pass a director under the foreskin in the middle line of the dorsum, and to cut the tissues along this with a scalpel or strong scissors down to the sulcus. The bleeding up to a certain point, will be beneficial, but it can be easily stopped by pressure, or by the ligature of any spouting vessel.

The phimosis which results from such an inflammation, but which has not required slitting up in its acute stage may be operated on later in the more artistic method we considered first. This may sometimes be the best plan, but more often it will be found advisable to divide the prepuce along the dorsum, and then to readjust the divided skin and mucous surfaces in the most symmetrical way possible.

Paraphimosis.

Paraphimosis.

In this condition the glans penis and some of the everted mucous membrane of the foreskin is strangulated by the narrowed aperture of the natural or acquired phimosis, through which it has protruded, but cannot be returned in consequence of the œdema, In children, a natural phimosis is generally the cause; in adults, as a rule, the case is one of balanitis with inflammatory effusion and contraction of the foreskin. In any case the condition causes pain, and will get steadily worse until it is relieved.

Reduction.

In children, and in the less severe forms in adults, the foreskin can, as a rule, be drawn over the glans without much difficulty. The part having been first well oiled, the size of the œdematous glans can be reduced by wrapping a piece of lint round it and firmly grasping it in the hand for a minute or so, after which, by pressing it directly backwards with the thumb, at the same time drawing the foreskin forwards with the first and second fingers of both hands, the prepuce will come over.

In more severe cases an ice bag may be found useful, or the swollen tissue may be stabbed with a scalpel in several places, thus reducing the œdema.

Incision.

If these measures fail, the patient should be given an anæsthetic, and if reduction still cannot be effected, the constricting ring must be divided along the dorsum of the penis. This ring will probably be found to be very deeply imbedded in the swollen parts, so that care must be taken to identify the real seat of strangulation. If a paraphimosis be not reduced, the parts fall quickly into a sloughing condition, which will eventually relieve the constriction at the expense of deformity, through the loss of portions, or it may be of the whole of the glans penis.

It will often be advisable to slit up the foreskin at the same time that the paraphimosis is relieved by incision, but this should be done after the reduction of the glans, as the natural condition of the part can then be more accurately seen.

Of corns.

Of Corns, Warts, Condylomata, etc.

The common corn which generally forms about the foot deserves perhaps more notice than it generally gets, for it often occasions much suffering, and may even effect complete disablement.

These growths like other forms of papillomata may be removed with the knife, but this operation, small as it seems, should not be very lightly undertaken, for even small corns dip deeply into the subadjacent tissues, and will certainly recur unless they are completely removed, while all cuts about the foot refuse to heal kindly, so that the patient may be laid up for a good while. Professional corn cutters as a rule confine their efforts to diminishing the amount of direct pressure upon the sensitive papillæ, by judicious paring of the horny layers, but when they do attempt to remove the whole growth, they commonly effect it by setting up a little suppuration about or beneath its base. In other cases, a caustic, nitric acid being the best, is applied time after time; the burnt parts being pared away.

But in the great majority of cases, palliative measures in the way of relief of pressure by properly cut corn plasters will effectually prevent pain without laying up the patient for an hour, and in the end will generally cure the corn.

"Corn plasters" as sold are too small, and are of the wrong shape They should be cut to a pattern out of isinglass felt, or out of a similar adhesive stuff, and should be of a shape ⊂ open towards the ankle, to allow of free circulation. The sides of the ⊂ should be at least thrice the thickness of the central space, which should just admit the corn. The plasters can be taken off at night and put on again in the morning.

Warts.

Warts upon the hands are common in children, and in those who have to handle animal tissues (*post-mortem* room men, and the like). In children they commonly disappear, vanishing sooner or later without being noticed. The best way to remove them is to touch them repeatedly with nitric acid and pare them away.

Urethral caruncle.

Urethral caruncles occur about the aperture of the female urethra, and are exquisitely tender. It is generally necessary to give an anæsthetic before removing them, which is best done with the actual cautery, or with scissors, afterwards applying the cautery to their bases, to arrest the bleeding, or the application of a 4 per cent. solution of cocaine will allow them to be snipped off, and the cautery to be applied quite painlessly.

Removal of warty growths.

Warty growths of venereal origin are common about both the male and female genitals. They may generally be snipped off with scissors and their bases touched with lunar caustic, or nitric acid; but sometimes they are so large, that it is safer to ligature them, when the method detailed for piles may be followed. In other cases, when they are more sessile, the application of nitric acid will be best.

Condylomata.

True condylomata, moist cutaneous tubercules, are sometimes treated locally with the stronger caustics, but more frequently powders which are somewhat escharotic, but which also serve to keep the parts dry, are preferred. Thus equal parts of calomel and zinc oxide, or of verdigris and savin may be used. These also yield to constitutional treatment much more readily than warty growths.

Of fistulous tracks in the groin and elsewhere.

Of Fistulous Tracks in the Groin and elsewhere. Sinuses in the groin are very common as the result of buboes, and once formed, will burrow to an almost unlimited extent. But wherever the sinus may be, the same line of treatment must be adopted, as has been before described for fistula in ano. It is hopeless to expect any healing until the tunnel has been converted into a trench, and made to heal from the bottom. The windings of the fistulæ must be followed up with the director and scalpel, and the details of scraping, trimming and dressing, are precisely as before described. We should, however, add here, what we omitted to mention before, namely, the great use of an occasional application of lunar caustic to the edges and base of the trenches.

Of Ingrown Toe-nail, and Avulsion of Nails.

Of ingrown toe-nail, and avulsion of nails.

The great toe-nail often produces an extremely painful ulceration, on one or both sides, by an ingrowth of its margins. The irritation thus produced causes a hypertrophy of the neighbouring skin, and a condition of paronychia, so that the nail may come to be half buried in fungous granulations, with a fœtid discharge, and the patient may be unable to put his foot to the ground. There are probably very few, if any, cases of ingrown toe-nail which *cannot* be cured by measures short of pulling out the nail, but in all except the slighter forms, much time and patience will be required to achieve success.

Cure without avulsion.

If the nail is to be kept, the common treatment is to gradually lift it up from its bed, by gently packing something, such as a pledget of cotton wool, beneath its edge, three or four times a day; and at the same time to reduce its thickness to that of a piece of note paper by rubbing it down, for which purpose pumice stone will be most serviceable. The exuberant edges may be touched with caustic; and iodoform, or the powder of the nitrate of lead, will be found good applications to the ulceration.

Master's method.

The use of a small piece of sheet lead slipped beneath the nail to raise its edge has long been known, but we believe that the following plan, for the knowledge of which we are indebted to Mr. H. T. Masters, of Whitchurch, is as original as it is certainly successful. A piece of silver, about the thickness of note paper, and about ½ an inch long, and ¼ of an inch broad, is bent to the shape of A. B. in Fig. 232 (this can very conveniently be made out of a threepenny piece filed down), one end, B, being bent up to a right angle.

This end is inserted underneath the nail so that the ingrown edge just rests in the groove thus formed. The rest of the plate must then be used as a lever, and pressed down upon

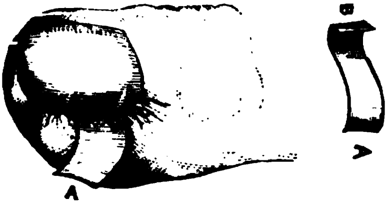

FIG. 232.—*Silver Lever for Ingrown Toe-nails.*

the side of the toe until it lies against it as shown in the illustration. By this means the edge of the nail is raised, and the exuberant granulation tissue, which is almost always present, pressed down, and away from it. The plate is then fixed in position by a circular turn of strapping, cut about an inch wide (not shown in the figure).

The relief afforded by this simple adjustment is immediate and very striking, so that patients can walk with ease as soon as the plate is fixed, and a permanent cure is generally speedy.

Working on these lines, as we have said, almost all ingrown nails can be cured, and the patient can himself assist the process greatly; but it takes time, and it may be readier and more satisfactory to remove the nail.

Removal of nail.

If this plan be chosen, the whole nail should be removed, not the ingrown half, as is sometimes recommended. An anæsthetic having been given, the surgeon runs one blade of a strong pair of scissors beneath the centre of the nail, down to its root, and cuts it in two. Then with two pairs of forceps he twists the two halves inwards and outwards, and pulls them off. All bleeding is easily arrested by pressure, and the part is lightly dressed. Any trimming of the edges that is required should be done at the same time. Other nails, both of fingers and toes, may require removal for onychia, abscess of matrix, injury, etc., but in such cases it will generally be best, in preference to splitting the nail and wrenching it off, to gently separate the nail from its bed, until it can easily be pulled away; this is especially the case in removal of a finger nail, where great care is required lest the matrix itself should be scarred; the results will not show at the time, but as the new nail grows, the cicatrix in the matrix will cause the nail to be permanently misshapen.

Warty growths beneath nails.

Warty growths not infrequently form from beneath the nails, and especially from beneath the great toe-nails. They will, if neglected, cause pain and ulceration by pressure, and it is always best to remove them. This may generally be done by paring, and the use of some caustic; but it may be necessary to remove a portion, or the whole of the nail in order to get at the base of the growth.

Sub-ungual exostosis.

A small cancellous exostosis is also apt to form beneath the nail of the great toe, and this is often mistaken for a warty growth, but its nature will be recognised by any properly careful examination. It should be removed early, for if it be allowed to grow, it will be sure to occasion inconvenience. The best method of getting it away is to pass a scalpel round its base, cutting all the tissues down to the bone, and then to snip it off with small sharp bone forceps. As in the case of warts, it may be necessary to remove a part or the whole of the nail for the sake of exposure.

Two infantile conditions remain for notice, namely, *Tongue-tie*, and *adhesion of the vaginal margins.*

Tongue-tie.

Mothers frequently bring their infants to the hospital in the belief that they are tongue-tied, when either there is nothing the matter with them, or else there is only a fragile band of membrane which can easily be broken down with the finger. But if the frænum linguæ be really too short and thick, it must be divided with a pair of blunt pointed scissors, the points of which must turn downwards, towards the floor of the mouth. The tongue must be held up by two fingers, or by that special form of spatula with a slit in it, combined with a director, which may often be found in pocket instrument cases.

The tongue should be freed more by tearing than by cutting.

Vaginal adhesions.

Very commonly indeed, newly born female children are brought with the report that "the womb is shut," or some similar phrase is used; when, upon examination, a small pin-hole aperture is seen, by which the urine escapes, and at first sight the rest of the vaginal opening seems to be absent.[*] But if a probe or director be passed into this opening, and pressed downwards, it will be seen that the parts are perfectly normal, and that there has been only an adhesion of the margins of the vaginal orifice.

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[*] We have known medical men advise infants to be taken long journeys to a hospital for operation, this condition being supposed to be one of imperforate hymen, or of absence of the vagina.

No further treatment is required, and we mention the condition only because it is so often mistaken by mothers and dressers for something far more serious, whereby much anxiety is caused.

CHAPTER XXXVII.

OF VENÆSECTION, CUPPING, ETC., AND OF BLISTERS AND OTHER METHODS OF COUNTER IRRITATION.

Of Venæsection.

Of venæsection.

The practice of venæsection is so much out of fashion that probably the majority of house surgeons now in office have never seen the operation performed, still less performed it themselves. It is to be hoped that so effectual and certain a remedy will soon become again more general, and it is most unlikely that it will ever really die out of use.

The veins which are suitable.

The veins which are opened for the purpose of letting blood, are, one of those at the bend of the elbow, the jugular, and much more rarely, the internal saphena at the ankle. The method is much the same in each case, and we will describe in detail only the commonest, namely, of one of the veins at the bend of the elbow, usually the median basilic.

Method.

The patient, who should be sitting, is directed to hang the arm down so as to produce turgescence of the veins. A piece of bandage is then tied tightly round the arm, a pad being placed over the trunk vein on the inside, and the bandage knotted over that. The hand should then be raised to the horizontal position, and be made to grasp a strong pole resting on the ground (the origin of the barber's sign pole), a broom handle will do very well. The limb is thus steadied, and the forcible muscular flexion aids the venous fullness.

Supposing the median basilic to be selected, the thumb should be placed just below the spot chosen for incision, so that the vein, and the skin over it, is steadied, and the blood prevented from spurting out. The surgeon then, with a lancet, or a very sharp knife (the former is best, from the extreme thinness of its blade) incises the vein obliquely, cutting it about half across. On removing the thumb, blood should immediately flow in a somewhat forcible stream, and this should continue until about five or six ounces have been removed; it will then generally slacken, and if more blood is to be drawn, the surgeon must rub the limb from below upwards, and direct the patient to alternately open and close the hand, or to flex and extend the elbow, so that the muscular contraction may aid the flow.

When as much blood as is required has escaped, the ligature on the arm must be relaxed, the arm raised, and a pad placed upon the wound. The pad should be secured by a double figure of 8, the ends being tied in a bow, or reef knot over it.

Complications of venæsection.

Complications of Venæsection.

If the instruments are perfectly clean, diffuse inflammation can hardly occur, but in older and ruder days this was not infrequent.

A more serious accident still, seems to have happened somewhat unaccountably often, namely a puncture of the brachial artery, or an opening of it in mistake for the vein. This sometimes resulted in the formation of an arterio-venous aneurism, or in an aneurismal varix, and sometimes in consequences still more serious.

It is very necessary that the wound in the skin and that in the vein should exactly correspond, and every care must be taken that the former does not slip over the latter during the incision. This is best prevented by using a very sharp lancet, and by fixing the vein firmly.

In cases where the vein is difficult to find, a careful exposure of the vessel by dissection will prove of great service. (See Transfusion, p. 56.)

Bleeding from the jugular vein.

Bleeding from the Jugular Vein is sometimes adopted in children from the small size of the arm veins, and in adults for other reasons. (See Apoplexy, p. 363.) The operation is conducted on the same principles as for bleeding from the arm, but the compress to produce distension of the vein must be applied very firmly above the clavicle, outside the sterno-mastoid, lest air should enter. The vessel is incised upon the sterno-mastoid, in its long axis, as the platysma fibres here cross it obliquely. The after management is the same as before, but the pad must be placed on the wound before the compress over the clavicle is relaxed.

Arteriotomy.

Arteriotomy is still more rarely performed than venæsection. The temporal artery, or one of its branches, is the only vessel opened for this purpose. It should be half cut through with a lancet, as in the case of the vein, but transversely; and when the desired amount of blood has escaped, the division of the vessel should be completed and a very firm compress applied, which should be left undisturbed for four or five days.

Cupping.

Cupping.

By means of "cups" the blood may either be merely drawn to the surface by taking off the atmospheric pressure, or it may, having been thither attracted, be removed by a scarificator. The former proceeding is "dry," the latter "wet," cupping. The nape of the neck and the posterior surfaces of the thorax and loins are by far the most common situations, but any part which will hold the glass will do.

Dry cupping.

In order to cup successfully some dexterity is required. The principle on which it depends is the creation of a considerable vacuum beneath bell-shaped glasses (Fig. 233), which are made in various sizes. These glasses are sometimes made so that they can be attached to an exhausting syringe, like the bell jar of an air pump. But in skilful hands a better vacuum is obtained by quickly rarefying the air by heat. A good cupper will do this by simply putting a lighted paper spill within the cup for an instant and immediately applying the latter to the surface of the skin; but for most people it will be easier to put a few drops of spirits of wine into the cup, and to distribute the spirit over its interior. A pledget of cotton wool placed on a stick should then be dipped in spirit, lighted, and mopped round the inside of the glass. This will produce a large but momentary flame, and as soon as it is alight, the cup should be "clapped" upon the required place. The flame will be immediately extinguished, and the vacuum will show itself by an almost instantaneous rising of the skin.

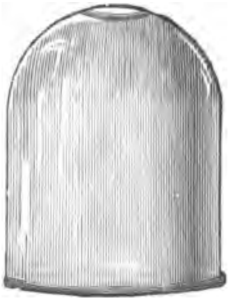

FIG. 233.—*Cupping Glass.*

The essential points to attend to are, that only just so much spirit should be put into the cup as will moisten its sides, and that the rim of the cup be applied perfectly to the skin, so as to exclude all air.

In *dry cupping*, six or eight glasses are frequently used, and in the absence of those of the regular form, wine glasses will do nearly as well, although their sharp edges are apt to cause pain.*

Wet cupping. If *wet cupping* is to be practised, one, two, or more glasses are placed on the skin as before; as soon as the skin has risen within them they are removed, and numerous small incisions are made in the swollen area, by means of a scarificator. The cups are then replaced (the measures for their exhaustion being repeated), and will quickly be nearly filled with blood. They then become loose and must be taken away with their contents. These cups can again be applied, if still more blood be required, and when the operation is over, the wound should be lightly and simply dressed.

The scarificator. The *Scarificator* (Fig. 234) is an arrangement of knife edges, protruding through a plate with slits in it, and having a set screw and trigger mechanism, so arranged that the depth to which the tissues will be divided can be determined, and that the knives shall only momentarily be protruded when the trigger is released. The depth desired is that which will incise the true skin, but not open up the cellular tissue below. If the cuts are too deep, pellets of fat will choke the incisions, and prevent the flow of blood. This instrument should be pressed pretty firmly against the skin surface when the trigger is released.

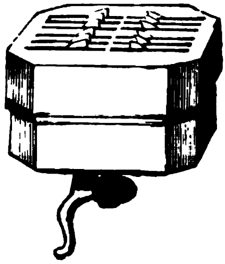

FIG. 234.—*Scarificator.*

We should not omit to mention the usefulness of scarification as a means of depletion in forms of local congestion, other than those for which wet cupping is indicated. Thus in acute orchitis, relief may be afforded by numerous punctures with a sharp lancet or scalpel; and some of the good effects of the incisions which we have already described as being essential in certain forms of erysipelas, are due to the local abstraction of blood thus effected.

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* An india-rubber cup of the same shape as the glass ones has been introduced, and appears to work well. The rubber is sufficiently stout to tend forcibly to recover its shape, after it has been squeezed out of it. Its bell-shaped cavity can thus be compressed, and its margin applied to the skin. When left alone it will be found to adhere with considerable suction.

Of leeches.

Of Leeches.

If leeches are to be applied anywhere within the cavity of the body, such as in the mouth, nose, vagina, etc., a leech glass from which they cannot escape should be used; but if they are required for outside surfaces, they may be placed within a pill-box, covered with a piece of lint, or held lightly in the hand. The part to be leeched should be washed with warm water, or milk, and must be perfectly clean. Those leeches should be chosen which are thinnest and most lively.*

It is estimated that a leech should extract from ʒj to ʒij of blood before it is gorged, but if a poultice be put over the bites, much more will flow.

A leech should never be allowed to bite into a vein, or troublesome hæmorrhage may follow; pressure would always stop this, in any situation where it could be applied, but it may be necessary to adopt such measures as passing a needle below the bite, and twisting silk round it, etc.

Of counter-irritation.
Of blisters.

Of certain Methods of Counter-irritation.

Of Blisters. These are usually produced by painting blistering fluid (Liquor Epispasticus P.B.) over the required area, or by applying a cantharides plaster, cut to the desired shape. If there are any hairs on the part to be blistered, they should be shaved off, and the skin washed with a strong soap, to remove the natural oil.

Any form of blister will rise less painfully, and more effectually under a light bread or linseed poultice. If the blistering fluid be used, the most convenient way to apply it is to cut a hole of the desired size in a piece of note paper, to hold it firmly over the part, and then to paint on the fluid with a camel's-hair brush. In this way the blister is strictly limited. Another plan is to smear simple ointment round the part to be blistered.

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* In old days at St. Bartholomew's, before the days of house physicians, there was a resident apothecary, who had charge of the leeching, then a very laborious task. We just recollect the last of these officers and his management of his leeches. He handled them, indeed, as Isaac Walton recommends that their cousin annelids should be handled, as though he loved them; in cold weather, always gently chafing them beside the fire between warm flannels, before he set them to their work.

The dresser or nurse must be careful to keep the hands well away from the eyes during the application of any blistering fluid.

When the bleb has fully formed, it may either be snipped at its most dependent part, and the serum soaked up with blotting paper; or if it be desired that the blister should remain open for some time, the whole cuticle should be cut off, and the sore dressed with some irritant ointment, of which the Unguentum Savinæ is the most frequently employed. (Blisters are occasionally dressed with mercurial ointment, when a powerful counter-irritation is required.)

Of the actual cautery.

Of the Actual Cautery.

We have so frequently considered the employment of different forms of the actual cautery for various surgical purposes, that we need only here remind the reader that in addition to its employment for the arrest of hæmorrhage, the removal of growths, etc., the cautery has a large field of usefulness as a most effectual counter-irritant. Thus for chronic diseased conditions of joints, "firing" is often very successful, as it is also for the relief of neuralgias, such as sciatica.

Whether the cautery irons, or Pacquelin's instrument be used, the usual method is to "score" the skin surface over the seat of pain or disease, very much as a horse's leg is fired. But in the treatment of spinal disease by the various forms of thermo-cautery, other methods are adopted, such as the needle cautery, etc., descriptions of which will be found in books especially dealing with this subject.

Of setons.

Of Setons.

The use of setons is the last method of counter-irritation which we shall mention. These are foreign bodies, introduced, and retained, beneath the skin, in the neighbourhood of diseased organs or tissues.

The regular "seton knife," formerly used, was a thin, double-edged, flat-bladed one, shaped like a small spatula. It was run through a pinched-up fold of the skin, and the slit thus made was occupied by a flat, ribbon-like piece of whalebone, gum elastic, or ivory. But at the present time, the general way is to pass two, four, or more strands of silk or whipcord, by means of a stout-handled needle, having its eye near the point. This is entered, and passed for a sufficient distance beneath the skin, and is then double, or quadruple threaded. The needle is then retracted, and the ends of the threads thus placed are loosely tied together. In the course of a day or two, they will begin to make a suppurating track. They are then worked to and fro, to keep up the irritation as long as may be desired.

Of Vaccination.

Of Vaccination.

The chief *plans* of vaccination are: (1) From arm to arm; (2) by means of tubes containing lymph from ripe vesicles; (3) by means of ivory points which have been dipped in the lymph and allowed to dry; and (4) by means of tubes of calf lymph.

The chief *methods* of vaccination are: (1) By means of small oblique punctures into the cutis vera, made with an arrow-headed lancet, charged with the lymph, this being procured direct from the vesicle, or from a tube; (2) by inserting the ivory points into such punctures, these having been moistened the instant before by being dipped in warm water; (3) by making within a small area, numerous scratches through the cuticle, like the cross hatching of an engraving, and then rubbing in the lymph from the vesicle, tube, or point, for a minute or two.

Arm-to-arm method.

There is little doubt that this last method is the most generally trustworthy, although it is somewhat more troublesome. If the arm-to-arm plan be adopted, the lymph, quite free from blood, must be taken from a matured vesicle on the eighth day after inoculation, by puncturing its upper pearly portion, from which slightly opalescent droplets will exude. The lancet may be charged with this, and inserted as has just been described, or a scratched area may have the lymph rubbed into it with some rounded instrument like the end of a common penholder.

In all cases, for a primary vaccination, three inoculations should be made, and the place nearly always chosen is the top of the arm, near the surface of the deltoid.

By ivory points.

If *ivory points* be used, the best plan, as has just been stated, is to insert them into small oblique incisions made with an arrow-headed lancet; or they may just be dipped in water and rubbed upon the scratched surfaces. These points are the least satisfactory of all methods of vaccination, but they are convenient.

By capillary tubes.

The lymph which is enclosed in capillary tubes is procured from ripe vesicles. The tubes being immediately sealed hermetically, humanised lymph will, under these circumstances, keep for a long time. When it is to be used, the ends of the tube are broken off and the contents blown out upon a clean slip of glass. The vaccination may then be performed with a lancet or by scratching with a needle as before. These tubes can always be procured from Whitehall.

Calf lymph. The methods of vaccination with *calf* lymph are precisely the same as with the humanised kind. It may be performed direct from calf to child, or by means of tubes, but in the latter case, it is now known that the lymph will only be certainly successful, if used within a few days of the time the tubes were charged.

It is absolutely necessary that all instruments, etc., used for the purposes of vaccination should be scrupulously clean.

SECTION X.

CHAPTER XXXVIII.

ON THE PREPARATION OF PATIENTS FOR OPERATION, AND THEIR AFTER-TREATMENT.

Of the preparation of patients for operation, etc.

Of the preparation of patients for operation, etc. In the case of an operation upon a child, the house surgeon should always be sure that its parents, or responsible relatives, understand and consent to its performance. In many cases it will be found much harder to gain this consent than if the operation had to be performed upon the persons of the parents themselves. With most hospital patients argument is of little avail, and a plain statement of the facts and issues of the case, will be found to outweigh any eloquence. The ward sister will also be found an invaluable auxiliary in cases where persuasiveness is required.

No operation should ever be performed on an adult without his consent, and here also tact will be required; patients much more commonly object to come into a hospital for an operation, than refuse to undergo it when it is put to them after they have been in the wards a short time, when they have learned to know and trust the surgical and nursing staff, and to recognise that the large majority of patients operated upon recover. It is therefore sometimes wise to defer the question of the necessity of an operation until the patient has been admitted for a little time, and has become used to the ward.

But although a patient may be so far managed for his own benefit, mere good faith demands that in all cases the necessity, or desirability of the operation, its possible results, and its risks, should be fully explained to every person, before they submit themselves to it, and neither honesty nor policy demands that its importance should be minimised. We do not mean by this that any view but the most cheerful one should be taken. It is not wise or necessary, for example, that a woman with a scirrhous growth in the breast, should have the statistics of recurrence forced upon her attention, but the facts should rather be emphasised that life is undoubtedly prolonged, and health and comfort retained by an operation which is not in itself dangerous, and that complete removal has resulted in permanent cure.

In women, the date of an operation should be arranged to fall as far as possible from a menstrual period, unless they have ceased to menstruate, but in cases of urgency the flow of the menses should not be made a bar to the operation.

The evening before the day of operation, a mild purgative should be given, and it is also wise to give a simple enema upon the morning of the day itself, so that the patient may not be troubled by the presence of hardened fæces in the rectum, if, as commonly happens, the bowels are not opened for a few days afterwards.

In cases of hæmorrhoids it should be ascertained that the enema has been returned.

Directions as to the appropriate dieting of patients previous to taking an anæsthetic, have already been given. (See page 397.)

Cleansing of skin.

If the part to be operated upon be hairy, as the head, pubes, or axilla, it should be shaved beforehand, and had better be washed with soap, and with water containing a little soda, so as to remove the natural oil from the skin.

Clothing.

The clothing which the patient is to wear during the operation must be light, and warm, and loose, and so arranged that the part to be operated upon can be easily exposed with little disturbance of the rest of the body.

In hospital, it will save the patient needless distress of mind for the anæsthetic to be administered in some place other than the operating theatre, crowded with students.

Warmth.

If the patient be feeble, or the operation a protracted one, a precaution which is too often neglected is to keep a hot water tin at the feet during its performance. The operating room must in all cases be properly warmed, and during the operation the bed to which the patient is to return, must also be warmed, and should have hot water tins placed within it beneath the under sheet.

The crowding round the operating table of any bystanders beyond the surgeon and the necessary assistants, should be absolutely prohibited, and students fresh from the dissecting, or *post mortem* rooms, should not be allowed to come near.

Instruments and sponges.

All instruments which are likely to be required should be got ready and examined beforehand by the house surgeon, and are generally placed in trays containing carbolic acid solution, 1 part in 20; if sponges are used they should be kept in their carbolised solutions until they are wanted. (See page 234).

Especially should those instruments which may be required for the arrest of hæmorrhage be carefully kept ready to hand, and the condition of the edges of scalpels, and the points of needles looked to.

Watching of patient after operation.

At the conclusion of the operation, when the patient has been put back into bed, the head should be kept low, to avoid any faintness, and a special nurse, or a dresser, detailed to watch the course of events for the next few hours. Patients must never be left alone to come to themselves after operation, for not only may reactionary hæmorrhage occur, but it sometimes happens that recovery from anæsthetic unconsciousness is marked by a delirium of more or less violence, during which the patient may tear off the bandages, or do other mischief.

Importance of a good night.

It is very desirable that the patient should have a good night after undergoing an operation, and a late visit should be paid by the house surgeon to ascertain this point. If there be much restlessness, an injection of morphia should be given in preference to opium by the mouth, but this drug, or chloral, or any other hypnotic, should not be ordered as a matter of routine, for it frequently happens that the trials of the day will produce a sound natural sleep.

Vomiting.

Vomiting after an operation is generally due to the action of the anæsthetic, and is sometimes a very serious complication; it may be set up by allowing food to be taken too soon. In all cases the patient should be directed to lie quite still, and must never be encouraged to be sick, with the idea that the emesis will give relief. Lumps of ice, or ice cold water, with a little brandy in it if required, will generally check this. Morphia in small doses (say $\frac{1}{8}$ to $\frac{1}{6}$ gr.) may be injected hypodermically. Bromide of potash and small doses of ipecacuanha may be useful in this condition, and iced champagne is often ordered for its relief, but in most cases the nausea will be most readily checked by keeping the patient still, and giving only iced water, or iced milk and water, by the mouth.

Action of bladder.

Inquiry should always be made as to the action of the bladder after an operation. If six or eight hours pass without the urine being passed, hot flannels, or a poultice should be placed over the supra-pubic region, and as soon as there are physical signs of distension, if the warmth thus applied does not give relief, a catheter must be passed.

Best time for operating.

Other things being equal, the morning hours (say from 9 to 10 o'clock) are the best for operating, and it may be said broadly that harm only can come from the presence of the patient's friends either shortly before, or from twenty-four to forty-eight hours after any serious operation.

Condition of bowels.

If the bowels are not opened naturally by the third day after the operation (except in herniotomies or other abdominal cases), a dose of castor oil, followed by a simple enema is generally all that will be required.

Poisoning from antiseptics.

Poisoning from Antiseptics.

Under the present system of dressing wounds poisoning occasionally occurs from absorption of drugs used in the lotions or dressings, and the house surgeon should remember the possibility of this occurring, and be able to recognise the early symptoms. Perchloride of mercury, carbolic acid and iodoform, are the three antiseptics most liable to be followed by toxic effects, and a brief account of the most common symptoms will be here given. The signs are often vague, and a certain diagnosis may be impossible, but in any case of doubt the method of dressing should at once be altered.

Perchloride of mercury.

Perchloride of mercury. Poisoning most frequently occurs after large irregular cavities have been washed out with a strong lotion, some of which is retained and absorbed. The chief symptom is diarrhœa with abdominal pain and distension, and blood also may be passed per rectum. Salivation is rare. There may be at first some rise of temperature. Death occurs either from collapse or the exhausting effect of the diarrhœa. Post mortem, imflammation and ulceration of the intestines will be found, usually most marked in the large gut.

Carbolic acid.

Carbolic acid. Under the old Listerian method of dressing it was not unusual for the urine, yellow when first passed, to become of an olive green colour on standing; or it might be tinged when first passed, the colour deepening afterwards, until it became almost black. This condition by itself is not of any great importance, but when poisoning occurs there are other symptoms added, of which severe vomiting is the most important. The temperature usually becomes subnormal, and a condition of collapse supervenes, with a rapid feeble pulse, fixed pupils and muscular twitchings, ending in death. The sulphates also disappear from the urine and albumen may be present.

Iodoform poisoning is rarely seen in England where the drug is used in much smaller quantities than abroad. The symptoms are very variable, and the diagnosis is often difficult. In some cases there is simply collapse, in others, a high temperature. The pulse is frequent and feeble, and there may be wild delirium, or drowsiness, especially in children. The patient rapidly emaciates, there is loss of appetite, and a complaint that everything smells and tastes of the drug. **Iodoform.**

In all cases of poisoning the first and most obvious treatment is to discontinue the use of the toxic drug, and the wound should be thoroughly cleansed with a non-poisonous lotion, such as boracic acid. **Treatment.**

In carbolic acid poisoning the frequent administration of small doses of sulphate of soda has been recommended, and should be tried.

CHAPTER XXXIX.

ON THE MAKING OF POULTICES, FOMENTATIONS, ETC.

Poultices, etc.

POULTICES are to be applied in *surgical* cases when a superficial inflammation is to be allayed, the process of suppuration hastened, or when any wound or sore has assumed a sloughing or otherwise unhealthy character. In *medical* cases their useful action is less direct, inasmuch as they are mainly intended to reduce an inflammation of parts at a distance from the skin surface to which the heat and moisture are applied. But in all cases the immediate object to be served by putting on a poultice is to warm and moisten the tissues with which it is in contact. The manner of its action is partly mechanical, for by relaxing the tissues, pain and tension are reduced; and partly physiological, as it affects, primarily, the circulation of the part poulticed, and secondarily the tissues or organs at a distance.

Materials for making poultices.

A great variety of materials have been used at one time or another for making poultices, carrots, turnips, potatoes, etc., but we shall here consider the following only:—

1. Poultices of crushed linseed meal.
2. „ „ „ with charcoal.
3. „ „ „ with mustard flour.
4. „ oatmeal.
5. „ bread.
6. „ starch.
7. „ „ with iodine (Marshall's).
8. „ bran.
9. „ yeast.

Linseed meal poultice.

The common *linseed meal poultice* is the one in the most general use, and is the easiest to make. The *crushed seed*, not the ground linseed flour, should always be chosen, for the former still retains a good deal of oil which gives a surface to the poultice mass, and prevents it from sticking to the skin.

How to make.

All that is necessary to make a good linseed poultice is to see that the water is boiling to begin with, and to waste no time in the mixing. The general plan is to scald out a pudding basin, to put into it the linseed, and to add boiling water gradually, stirring the mass with a warm spoon; or if it is preferred, the water may be put first into the basin and the meal gradually added; or again (and in this way all cooling of the poultice mass during mixing is avoided), a sufficient quantity of water may be kept boiling in a saucepan upon the fire, and the linseed gradually stirred into it. In any case, when the proper consistence has been reached, the contents of basin or saucepan should be emptied out upon a piece of old linen or cotton stuff, of the shape of, but a little larger every way than the poultice required, and quickly spread with a spatula, or large knife (an ivory paper knife does well), which must be kept well wetted with boiling water, until it is everywhere about ¼ inch thick. This spreading should have distributed the mass evenly over the stuff, up to about an inch of its edges; this inch must now be neatly turned over upon the margins of the poultice to which it will adhere.

Another good plan is to card out tow and fashion it into a bed for the poultice mass. The manipulation of the tow requires some practice, and can hardly be described in words, but it forms a very light non-conducting backing.

If the mean has been hit between sloppiness and dryness, the poultice should now be able to be folded up or handled freely without coming to pieces, and its surface should be smooth and non-adherent to the skin, to which it should be, when first made, still too hot to be applied.

If it be desired to keep a poultice hot for a little time before it is applied, or if one has to be carried for any distance, it is best to fold it up and place it between two hot plates.

Poultices should be applied as hot as they can be borne, and to get the full benefit of them they should be changed at least every two hours, for whatever they are made of they soon get stiff and cold; as a rule, every three or four hours is considered to be the time for changing poultices, and in hospital it is perhaps hardly possible that it should be otherwise. But under no circumstances should eight or ten hours be allowed to pass, for by that time the poultice will have become sour.

Of whatever kind the poultice may be the surface of the mass must be placed upon the skin itself, without the intervention of any woven stuff, even of the thinnest muslin.

If oiled silk or oiled paper be placed over the back of the poultice it will retain its heat and moisture better.

All old poultices should be burned directly, never allowed to remain in a ward, or be thrown into a dust-bin.

An aseptic character is thought by some to be given to poultices, by making them with condy, carbolic lotion, sanitas, or liq. carbonis detergens, instead of with simple water. Of these fluids, the two last are the best, and are certainly of some use in the case of foul or sloughing wounds which are being poulticed.

Charcoal. *Charcoal poultices.* A more distinct antiseptic action is supposed to be exercised by poultices made of three parts of linseed to one of charcoal in powder, but the powder used in this way has much of its disinfectant power destroyed, and it is much better to sprinkle it in the dry form over the wound, and then to apply an ordinary poultice over all.

Mustard. For counter-irritation mustard flour may be added to the crushed linseed in varying proportions (generally equal parts of each), and the poultice made as before. These "mustard plasters" are largely used in domestic medicine, but they are often a useful stimulant in surgical cases, as in cold, or callous ulcers of the legs.

Such applications as iodoform, or opium in powder, are sometimes dusted upon the surfaces of poultices; or laudanum, or the tincture of belladonna, may be sprinkled over them for anodyne purposes, but this is not generally considered a good way of administering such local remedies.

Oatmeal. *Oatmeal poultices* are commonly used in Scotland, but more rarely in the south of England. They are somewhat heavier than linseed ones, but in the respect of caking when cold, etc., they are practically identical; they are also made in just the same manner.

Bread. *Bread poultices* are also in very common use, although they are rather difficult to make of the right consistence, neither sloppy nor crumbly, and so as to be non-adherent to the skin. Their lightness is their chief merit.

The readiest way, but one which will do only for small poultices, is to take a slice of stale bread without crust, to place it in a scalded basin, and pour boiling water upon it. The basin should then be kept hot upon the hob, or in an oven for a few minutes. Then the water should be poured off it as completely as possible, and the remaining bread pulp spread out upon linen or tow as in the case of linseed. But no large bread poultice of any consistence can be made in this way; if this be required, the crumb of a very stale loaf should be passed through a grater until it is like coarse flour. The poultice can then be made in the same way as a linseed one, and if spread out to a similar thickness will be a much lighter poultice. The lack of any natural oil in the bread must be made up by pouring a little olive oil over the surface of the poultice when made, or it will stick to the skin.

Starch.

A starch poultice is non-irritant and keeps its heat well. A stiff starch *paste* should be made with cold water in a basin, and then enough boiling water added to bring this to a proper consistence, the mass being then spread upon linen.

Starch and iodine.

Starch and iodine chemically combine to form a mass which may be termed a cold poultice, and which is a very useful application for syphilitic ulcerations. It is made by adding ʒss liq. iodi to a hot starch jelly, which itself has been made by adding ʒvj of boiling water to ʒij of starch.

Bran.

Bran poultices are made simply with bran and water; they are light, but do not retain heat well.

Yeast.

Yeast poultices are the last we shall mention. One form consists simply of a mass of warm dough which is at the time fermenting through the action of yeast added to it (either of brewer's yeast or any other kind), the quantities required being roughly 14 oz. flour, 6 oz. brewer's yeast, 6 oz. hot water (*i.e.*, 100° F.).

Another form of yeast poultice is made by spreading warm yeast over an ordinary linseed or bread poultice. Both kinds have been supposed to exercise a special cleansing action upon sloughy wounds, gangrenous parts, and the like.

Fomentations.

A fomentation is made by soaking a piece of flannel in boiling water, and wringing it as dry as possible in a warmed towel. Some few people, laundresses especially, are able to perform this wringing with their unaided wrists, but for most it will be necessary to use a set of wringing sticks. These consist of two pieces of stick-like rulers, about 2ft. 6in. in length, passed through the ends of a round towel, about 2ft. 6in. by 10in. When the soaked flannel is picked out of the boiling water it should be allowed to drip for a few seconds, and then it must be placed in the centre of the towelling, and the whole twisted up by the leverage of the sticks, until no more water comes away. This should take but a few moments. Another good way is to sew the ends of the flannel together and to pass the sticks through, before the boiling water is poured on to it. It can then be lifted and wrung without loss of time, and put into a dry warm towel.

For a simple fomentation the flannel should just be applied to the skin as an application of warmth and moisture, and covered with a piece of oiled silk slightly larger than the fomentation; over this again a layer of cotton wool should be laid, and the whole fixed with a triangular bandage or a few turns of a roller. Instead of ordinary flannel, boracic lint is frequently used, and has the advantage of being antiseptic. But these fomentations are often used with some counter-irritant or anodyne; thus laudanum, or the tincture of belladonna may be sprinkled over the flannel, or turpentine is used more frequently still.

Turpentine stupe.

This last forms the common turpentine stupe, so often used for lumbago. In all cases if the fomentation is to produce its proper action, the flannel must be wrung dry out of boiling water, and if the wringing be not effectually performed, it is quite likely that some scalding of the skin will take place.

CHAPTER XL.

UPON SURGICAL CASE TAKING.

Surgical case taking.

THE art of taking notes of surgical cases well, is one not easily acquired, and for the notes to be of much value, something more than vague general notions upon surgical subjects must be pre-supposed. Yet in many hospitals, dressers who are beginning their work in the surgical wards, or clinical clerks in the medical ones, are expected to be able to write intelligible histories of cases which are themselves very possibly obscure to the last degree; and further, to write these so that their account shall stand for all time as being full, true, and particular, and so that those, who may on some future occasion require to look up the case books of the hospital, will find therein a trustworthy account of whatever case, or group of cases, may be under investigation.

Notes which will perfectly fulfil these conditions can hardly be expected, and will only exceptionally be obtained from dressers, at any rate during the first few months of their ward work; but nevertheless there is hardly any other part of these same dressers' work which will be so useful to him educationally, as his case taking. *Litera scripta manet*, and he will find that every case which he intelligently records (and therefore studies, because he *has* to record), will remain with him a lifelong experience.

What he must aim at in his case taking must be first and foremost, *absolute truth*, and it will be found that sometimes there is a strong temptation to make the facts square with a preconceived theory; and secondly, to present a clear story of the case, without introducing any personal opinions, letting the facts tell their own tale.

The notes of a case then, should comprise:—

Main points to be noted.

(1) A description of the patient, and of the symptoms, objective and subjective, presented by him (or her, but for shortness we will use the male appellation) when he first comes under the notice of whomsoever has to record the case.

(2) An account of those facts in his previous life history, and in his family history, which may throw light upon his present condition, and the sources of this information.

(3) The previous story of the illness, derived from the patient himself, his parents, or from other people, the source being in all cases stated,

(4) A *diary* recording the measures, operative and other, which are adopted for the relief of his complaint, after he has come under observation, and the subsequent course of events.

(5) The *result* of such treatment, namely, cured, relieved, unrelieved, or died, and in the last event,

(6) Whether or no a post mortem examination was made, and if so, an account of the results of this examination.

Scheme or plan for recording cases.

The following scheme will be found a generally convenient and workable plan for recording cases upon the lines we have here laid down.

Ward Name.	Sex.	Age.	No. of Register. Occupation.	Date of admission. Residence.	Date of discharge.	Result— Cured. Relieved. Unrelieved. Died.

By whom taken.	Name of Surgeon.	Date of taking case.

The patient's family history,
i.e., (*a*) If the parents are alive or dead, if the latter, at what ages, and how.
(*b*) Brothers and sisters? No. of, whether alive or dead, etc.
(*c*) Place of patient in his family.
(*d*) Results of enquiries about hereditary tendencies, as to gout, insanity, cancer, etc.

The patient's previous history,
including (*a*) previous illness.
(*b*) habits of life (state source of information).
(*c*) other facts bearing on this part of the case.

History of the present illness from its commencement up to the date of taking the case, as derived from the patient, or from his friends or relatives (state the source) given in as nearly as possible the words actually used by them.

The patient's condition at the time of taking the case.
(*a*) General description. Position of patient in bed. State of nutrition, local and general. Indications of a diathesis (*i.e.*, strumous, syphilitic, etc.) The condition of the organs of circulation, respiration, and digestion. The condition of the skin and of the glands. The temperature (noting time when taken). The appearance, sp. gr., and quantity of urine passed, and whether albumen is present or no. The condition of the organs of motion and locomotion. Sleep, its amount and character of.
(*b*) Description of actual seat of disease, its locality, its *objective* physical appearances, and the *subjective* abnormal sensations connected with it.
(*c*) Other noteworthy local abnormalities.

Continuation of record.

The "case" being thus taken, it will be the duty of the dresser, or of whomsoever is appointed to continue the record, to preserve a consecutive account of the course of events from the moment the patient comes under treatment.

If an operation be performed, it must be fully described, especial attention being paid to the following points:—

Description of operations.

The actual incisions and manipulations. The approximate amount of blood lost, and the condition of the patient at the close of operation. The number and method of insertion of sutures (if any used). The position of the drainage tubes. The plan of dressing the wound, the position of the patient subsequently in bed, and the nature of the anæsthetic.

If the operation be of the nature of *a removal*, either of a growth, or of a limb, the notes must always describe fully the part taken away. For example, if the thigh be amputated in its lower third, for disease of the knee, the details of the condition of the joint, and the ligaments, muscles, etc., in its neighbourhood, the cartilages and the bones, must all be fully pictured. Were the case one of an epithelioma of the lip, in addition to the naked eye appearances of the growth, its microscopic structure should also be given.

As the case goes on it will probably be found unnecessary to make daily entries on the case paper, but however chronic the disease in question may be, and however slow the convalescence, it will be found convenient to make some note of the patient's condition at the very least once, and as a rule, twice, in the week, upon the occasion of the surgeon going his rounds.

The patient's temperature is now commonly taken night and morning by a ward nurse, and entered upon a chart, appended to the case book. This plan is a good one in many ways, inasmuch as the observations are made at every 12 hours, and at the most suitable times, but it involves a certain risk that this condition of the patient may be overlooked by the dresser. It should therefore be a rule that the temperature readings should be entered in the notes, as well as placed upon the chart, in all serious cases.

When the notes record a patient's discharge the extent of recovery should always be noted, and in the case of death, the actual cause should be carefully stated, if it be apparent; in those cases where a post mortem examination is made, the results must be fully recorded, and the dresser should be especially careful not to lose this opportunity of clearing up obscurities, and verifying and correcting opinions formed during the patient's lifetime.

APPENDIX.

FORMULARY.

We here give the composition of the non-officinal preparations which have been mentioned in this book, with other local applications, dressings, etc., which will be found useful. Local applications and hypodermic injections alone are here considered.

LOTIONS.

1.—*Of Acetate of Lead.*

The Liq. Plumbi Subacet. P.B.

2.—*Of Acetate of Lead with Opium.*

The above with 1 gr. of extract of opium to 1 oz.

3.—*Of Alum.*

4 grs. of alum to 1 oz. of water (or more).

3A.—*Of Alum and Oak Bark.*

4 grs. of alum to 1 oz. of decoction of oak bark.

4.—*Of Boracic Acid.*

The saturated solution of boracic acid in water.

5.—*Of Extract of Belladonna.*

2 grs. of the extract to 1 oz. of water.

6.—*Of Calamine.*

6 drms. of levigated calamine, 6 drms. oxide of zinc, 6 drms. glycerine, 2 ozs. lime water to 12 ozs. of water.

7.—*Of Carbolic Acid.*

The glycerine of carbolic acid diluted with water from 1 in 20 to 1 in 60, or less.

8.—*Of Carbonis Detergens.*

2 to 4 drms. of the Liq. Carbonis Detergens (made by digesting coal tar in a tincture of soap bark, *Quillaia*) to 12 oz. of water.

9.—*Of Chlorate of Potash.*

10 grs. of chlorate of potash to 1 oz. of water.

10.—*Of Chloride of Zinc.*

1 to 4 grs. chloride of zinc to 1 oz. of water for a stimulant lotion; and 40 grs. to 1 oz. of water for washing over operation wounds for purposes of asepsis (is somewhat caustic).

11.—*Of Chlorinated Soda.*

30 ♏ of the Liq. Sodæ Chlorinatæ (P.B.) to 1 oz. of water.

12.—*Of Chlorine.*

The Liq. Chlori (P. B.) diluted.

13.—*Evaporating Lotion.*

1 drm. spirits of wine and 2 drms. of the solution of acetate of ammonia to 1 oz. of water.

14.—*Of Iodine.*

20 to 30 ♏ of the tincture of iodine to 1 oz. of water.

15.—*Of Nitrate of Silver.*

3 to 10 grs. of nitrate of silver to 1 oz. of water.

16.—*Perchloride of Mercury (Corrosive Sublimate).*

1 part in 800 of water to 1 in 2000.

17.—*Of Nitric Acid.*

2 to 4 ♏ of the strong nitric acid to 1 oz. of water.

18.—*Of Permanganate of Potash (Condy's Fluid).*

12 to 36 ♏ of the liq. pot. permang. (P.B.) to 1 oz. of water.

19.—*Refrigerating Lotion.*

30 grs of ammonium chloride, 1 drm. diluted acetic acid, 1 drm. spirits of wine to 1 oz. of water.

20.—*Of Sanitas.*

The patent preparation, as supplied, or diluted.

21.—*Of Sulphate of Copper.*

2 to 4 grs. of the sulphate of copper to 1 oz. of water.

22.—*Of Sulphate of Iron.*

2 to 6 grs. of the sulphate of iron to 1 oz. of water.

23.—*Of Sulphate of Zinc.*

2 to 6 grs. of the sulphate of zinc to 1 oz. of water.

24.—*Of Tartrate of Iron.*

½ to 1 drm. tartrate of iron to 1 oz. of water.

25.—*Of Terebene.*

The patent preparation of terebene diluted.

OINTMENTS.

1.—*Of Belladonna.*

80 grs. extract of belladonna, 1 drm. glycerine, 1 oz. prepared lard.

2.—*Of Boracic Acid.*

1 drm. boracic acid, 1 oz. lard.

3.—*Of Iodoform.*

1 drm. iodoform, 1 oz. lard, or vaseline.

4.—*Of Iodoform and Oleate of Zinc.*

2 oz. iodoform, 1 oz. oxide zinc, 6 oz. oleic acid, 14 oz. lard, or vaseline. (The odour of iodoform is stated to be thus much diminished.)

5.—*Of Mercury and Belladonna.*

Mercurial ointment and belladonna ointment, equal parts.

6.—*Of Mercury and Camphor (Scotts's dressing).*

1 oz. mercurial ointment, 20 grs. camphor.

7.—*Of Nitrate of Mercury, diluted.*

The P.B. ointment and lard, or vaseline, equal parts.

8.—*Of Oleate of Mercury (20 per cent)*[*].

2 drms. peroxide of mercury, 10 drms. oleic acid. (Requires frequent trituration for 24 hours for thorough preparation.)

9.—*Of Petroleum.*

120 grs. paraffin, 1 oz. vaseline.

LINIMENTS, ETC.

1.—*Of Belladonna and Chloroform.*

(1.) Equal parts of the two P.B. liniments.

(2.) 6 drms. liniment of belladonna, 2 drms. chloroform, 1 oz. compound camphor liniment, P.B.

2.—*Of Carron Oil (Linimentum Calcis).*

Equal parts of lime water and linseed, or olive oil.

3.—*Of Iodide of Potash.*

1 drm. iodide of potash, 2 drms. Liq. ammon. fortior, 2 oz. soap liniment.

4.—*Of Iodoform.*

(1.) A saturated ethereal solution (1 in 7), is used for painting on sores, etc., the drug being left as a pellicle, by evaporation.

(2.) Is also easily mixable with glycerine, and may thus be conveniently used in proportion of 10 grs. iodoform to 1 oz. of glycerine.

(3.) 1½ drms. iodoform, 1 oz. oil of Eucalyptus, 5 oz. olive oil.

5.—*Of Lead and Olive Oil.*

½ oz. Liq. Plumbi Acetatis, 3½ oz. olive oil.

6.—*Of the Sub-Acetate of Lead.*

A patent preparation (see page 277).

CAUSTICS.[†]

1.—*Arsenious Acid.*

20 grs. arsenious acid, 1 oz. lard, or vaseline.

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[*] The 10 p.c. oleate is a liquid—a liniment; the 15 p.c. is semi-solid.

[†] For other caustics, see chap. V,

2.—*Caustic Potash and Lime.*

Equal parts of potash and quicklime, with water (*q.s.*); is then moulded into sticks.

3.—*Nitric Acid.*

The strong acid is used. Should be applied with a splinter of wood, or with a brush made of glass hairs.

4.— *Sulphuric Acid (Ricord's Paste).*

Strongest sulphuric acid and willow charcoal, sufficient of each to make a paste.

5.—*Zinc Chloride.*

The chloride in fine powder may be rubbed up with wheaten flour in the proportions of 1 to 1, or ⅔ to 1, or ½ to 1, forming a paste by deliquescence. All solutions stronger than 10 p.c. are caustic in various degrees.

6.—*Ethylate of Sodium.*

Is prepared according to Dr. Richardson's formula; is applied with a glass rod or splinter of wood.

DUSTING POWDERS.

1.—*Of Calomel and Zinc Oxide.*

½ oz. of calomel, ½ oz. zinc oxide; or the same with the addition of 1 oz. of starch.

2.—*Of Fuller's Earth, otherwise Pulvis Terra Cimoliæ.*

3.—*Of Iodoform.*

4.—*Of Iodoform and Calamine.*

Equal parts of each in powder.

5.— *Of Savin and Verdigris.*

Equal parts of each in powder.

SUPPOSITORIES.

1.—*Of Galls and Opium.*

3 grs. powdered galls, 1 gr. opium, to 20 grs. oil of theobroma.

2.—*Of Iodoform.*

1½ grs. iodoform, 15 grs. oil of theobroma.

3.—*Of Opium.*

10 to 12 grs. of the compound soap pill (P.B.).

HYPODERMIC INJECTIONS.

1.—*Of Acetate of Morphia.*

The P.B. solution for injection contains 1 gr. in 10 ♏ (altered to this strength in the last edition), but provided that the solution be kept perfectly neutral, a solution of 1 gr. in 6 ♏ will often be found more convenient, especially if large doses are required. It may be thus prepared: To 352 grs. of hydrochlorate of morphia dissolved in 8 oz. distilled water, with heat, add 4½ drms. liq. ammoniæ, or sufficient quantity to produce slight alkalinity. When cool, wash the precipitated morphia by decantation, and on a filter, till free from chlorides. Drain well and dissolve in 1½ drms. distilled water, warmed, and 150 ♏ acetic acid, or sufficient to produce *slight* acidity. Make up to 4 oz. with distilled water, and filter.*

2.—*Of Morphia and Atropia.*

To the above add $\frac{1}{80}$ to $\frac{1}{40}$ gr. of atropia.

3.—*Of Apomorphia.*

2 p.c. hydrochlorate of apomorphia dissolved in water. Dose: 5 ♏ = $\frac{1}{10}$ gr.

4.—*Of Carbolic Acid.*

The pure acid with 5 p.c: of water (see p. 280).

5.—*Of Ergotine.*

15 grs. ergotine, 15 ♏ glycerine, 1 oz. water, and 1 p.c. pure carbolic acid.

Dose: 1 to 4 ♏ = ¼ to 1 grain ergotine.

6.—*Of Ether.*

10 to 20 ♏ pure ether, or of ether with equal parts of pure alcohol or brandy. (Page 358).

---

* Morphia injections keep better if 1 p.c. of pure carbolic acid be added, and if the solution be made up with 25 p.c. of glycerine in place of so much water, clogging of the needle by evaporation will be greatly prevented.

7.—*Of Pilocarpine.*

A 1 in 20 solution of the nitrate may be used in doses of $\frac{1}{20}$ to $\frac{1}{4}$ gr., *i.e.*, 1 to 5 ♏.

8.—*Of Perchloride of Mercury.*

The perchloride of mercury in aqueous solution, with the addition of a little glycerine, may be injected subcutaneously, or intra-muscularly, in doses of $\frac{1}{16}$ to $\frac{1}{8}$ gr.

ENEMATA.

1.—*Of Brandy (restorative).*

1 oz. brandy, 3 oz. strong beef tea.

Note.—For the purpose of nutrition various forms of peptonised fluids are now largely used as enemata.

2.—*Of Olive Oil.*

4 oz. olive oil, 15 oz. decoction of barley (or the oil may be used by itself). (See page 355.)

3.—*Of Soap.*

1 oz. soft soap to 20 oz. of hot water.

4.—*Of Starch and Opium.*

20 ♏ laudanum or Battley (Liq. Opii Sedativus). 20 oz. mucilage of starch.

5.—*Of Turpentine.*

$\frac{1}{2}$ oz. oil of turpentine, 1 oz. castor oil, yolk of 1 egg. Infusion of linseed to 20 oz.

FOMENTATIONS.

1.—*Of Belladonna.*

1 drm. extract of belladonna, 20 oz. (or less) of water.

2.—*Of Poppy Heads.*

1 to 3 ozs. of the dried poppy heads, sliced, without seeds, 20 to 40 oz. of water. Boil 20 minutes, and strain.

3.—*Of Turpentine (The Turpentine Stupe).*

Flannel soaked in boiling water, and wrung dry as quickly as possible with wringing sticks, then sprinkled with from 30 ♏ to 2 drms. of oil of turpentine. (See page 544.)

SPRAYS, ETC.

1.—*Lotions of Boracic Acid, Chlorinated Soda, etc.*

Can be used in the form of sprays, especially for ulcerations about the mouth and throat, or for dressing foul wounds, etc.

2.—*Of Carbolic Acid.*

The 1 in 20 solution of carbolic acid is generally used, but for directions for this and other antiseptic dressings, see page 239.

3.—*The Ether Spray for Local Anæsthesia.*

Ether purus P.B. may be used, or anhydrous ether, or a yet cheaper form, the "Anæsthetic Ether."

4.—*Of Sulphurous Acid.*

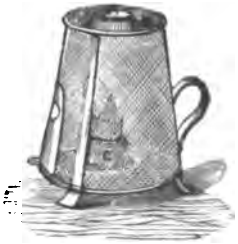
5 ♏ sulphurous acid to 1 oz. water.

5.—*Of Tannic Acid.*

5 to 20 grs. tannic acid to 1 oz. water.

6.—*Mercurial Vapour Bath.*

The following is Mr. Henry Lee's description of his mercurial vapour bath:—"It consists of a kind of tin case, containing a spirit lamp (Fig. 235). In the centre, immediately over the wick of the lamp, is a small circular tin plate, upon which the mercurial powder is placed. Around this is a circular depression, which is half filled with boiling water. The patient places this on the ground, and sits over it, or near it, on a small cane stool. He is then enveloped, lamp and all, in a circular cloak. When a cloak cannot be procured, a double blanket answers the purpose very well.



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